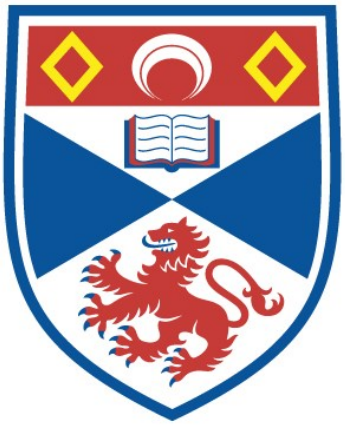
THE REPRODUCTIVE BIOLOGY AND TAXONOMY OF THE 'MYRTACEAE' OF THE DISTRITO FEDERAL (BRAZIL)

Carolyn Elinore Barnes Proenca

A Thesis Submitted for the Degree of PhD
at the
University of St Andrews



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Thesis presented for the degree of Doctor of Philosophy

Department of Biology and Preclinical Medicine

University of St. Andrews

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Declaration

I, Carolyn Elinore Barnes Proença, hereby certify that this thesis has been composed by myself, that it is a record of my own work, and that it has not been accepted in partial or complete fulfilment of any other degree of professional qualification.

Signed.....Date.14/sept/91

Statement

I was admitted to the Faculty of Science of the University of St. Andrews under the Ordinance General no. 12 in October 1987 and as a candidate for the degree of Ph. d. in October 1988.

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I hereby certify that the candidate has fullfilled the conditions of the Resolutions and Regulations appropriate to the degree of Ph.D.

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Abstract

Recent phytosociological studies in the Distrito Federal have shown that the Myrtaceae are the third ecologically most important family in the woody *stratum* of local savanna woodland, and that they may also be an important component in forests. The family, with c. 65 species in the area, is also the fifth in total number of species in the Distrito Federal.

The taxonomic treatment includes a key to the genera and monographs of Subtribes Eugeniinae and Myrtinae (which account for 39 of the species). The Eugeniinae are represented by genera *Eugenia* (15 species), *Myrciaria* (2 species) and *Siphoneugena* (1 species). The Myrtinae are represented by genera *Blepharocalyx* (1 species), *Campomanesia* (6 species), *Pimenta* (1 species) and *Psidium* (13 species). The biological and historical factors which create difficulties in the taxonomy of the family are outlined. Approximately 800 Distrito Federal numbers of Myrtaceae were examined, and an additional 500 numbers of extra-Distrito Federal material of the same species. Most of the examined material came from the local IBGE, HEPH and UB Herbaria, but E and K were also visited personally and had their collections surveyed; the following Herbaria sent material (mostly types) on request: BR, EG, G, M, S, U, UEC, US. Data was stored and manipulated using the Hypertaxonomy software designed by Dr. Flemming Skov for systematic studies in Botany; this runs on the Hypercard application of the Apple MacIntosh. Keys to flowering, sterile and fruiting material are provided and many new synonyms are proposed, some of which are tentative and must await consultation of type material. The distribution of the species showed that many had their northerly limit in the Distrito Federal region. The climate, which is the coolest in Brazil at this latitude, and has a reasonable amount of rainfall, may be responsible (allied to very poor soils), and the various isohyets and isotherms which underpin these distribution patterns were mapped for Brazil.

A review of the reproductive biology of the family is presented, which highlights the limited data available for the family in the Neotropics. Eight species were studied from the point of view of flowering phenology, floral and

pollination biology, breeding system and success of fruit-set. These were chosen with the purpose of giving an overview, both taxonomically and ecologically: *Eugenia dysenterica,* a savanna tree, *Siphoneugena densiflora,* a tall savanna woodland to gallery forest tree, *Blepharocalyx salicifolius,* a tall savanna woodland tree, *Campomanesia pubescens,* a savanna shrub, *Campomanesia velutina,* a gallery forest tree, and *Myrcia linearifolia, Myrcia rhodosepala* and *Psidium firmum,* all rather open savanna shrubs.

Results showed that all species were bee-pollinated and offered pollen as the floral reward, that flowers opened very early in the morning and lasted a day and that flowering strategies were 'steady state' 'big-bang' and 'cornucopia' as defined in classical studies by Alwyn Gentry. Buzz-pollination was registered in *S. densiflora. B. salicifolius* and *M. rhodosepala,* although anthers were non-poricidal, an unexpected finding with implications in the evolution of the Melastomataceae, one of the closest families to Myrtaceae, in which buzz-pollination allied to poricidal anthers is fixed. Pollinator-sharing by *Bombus* spp. bees occurred in the five savanna shrubs, *C. pubescens, M. linearifolia, M. rhodosepala* and *P. firmum.*

The two trees which occur in gallery forest, *C. velutina* and *S. densiflora,* are both self-incompatible, as well as *B. salicifolius,* which is one of the largest trees of dystrophic tall savanna woodland. The five other species, all shrubby except for *E. dysenterica,* have diverse degrees of self-compatibility although fruit-set was consistently higher after cross-pollination than after self-pollination. If pre-emergent reproductive success (PERS) is accepted as a dependable parameter to evaluate breeding system, all species are predominatly outcrossing. Precise synchronization of flowering, environmentally cued by the abrupt fluctuations in humidity of the air which occur at the dry season/rainy season transition, may be one of the factors promoting outcrossing in self-compatible species such as *C. pubescens* and *E. dysenterica.*

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CHAPTER 1 - INTRODUCTION

1. 1 The Myrtaceae

1.1.1 Taxonomy

The family Myrtaceae is one of the most taxonomically confused families in the Neotropics. It is likely that a combination of biological and historical factors are responsible for this.

Traditional herbarium taxonomy is ideally suited for taxa in which the differences between taxa are: 1) fairly easily perceived, e. g., do not require dissection, 2) well-preserved in dried material and 3) stable over the lifetime of the individual. In the neotropical Myrtaceae (Tribe Myrtoideae), these qualities are frequently lacking:

1) Several of the characters which are important at the generic level, such as the number of locules in the ovary, the number of ovules per loculus and the anatomy of the embryo require dissection.

2) Although flowers are well preserved in dry material, the fruits are fleshy and lose colour, shape and texture with drying.

3) Characters change markedly over time in an individual: branches peel, and from being tetragonal and hairy become terete and smooth, pubescence may be retained or disappear completely with time, inflorescence structures change between flowering and fruiting in so-called precocious flowering, i. e., inflorescence internodes grow and the vegetative bud beneath each flower bud forms a leaf that expands as the flower bud develops and eventually becomes a fruit. Finally, closed or nearly closed buds change dramatically as they mature, the lobes splitting apart or the calyptra detaching, so that even collections made from the same individual in different stages of development may look quite different. This creates problems in the herbarium - conversely, from a biological point of view it gives populations scope for neoteny, retaining or losing juvenile characteristics under different conditions.

Another striking feature of the neotropical Myrtaceae (Tribe Myrtoideae) is the uniformity of the flowers and fruits. The reason for this is that the tribe is predominantly bee-pollinated and bird-dispersed. This is a successful combination that may have been established rather early in the evolution of the

group (particularly as to pollination, see Crepet 1984, Proença 1991).

There are a few small differences in inflorescence, flower, fruit and embryo morphology between genera, but within a genus true structural differences are few and species are usually identified mainly by variation in size, size ratios and pubescence, such as occurs in other 'difficult' families, e. g., the Cruciferae or the Umbelliferae. Although there are some exceptions to this rule (see Review of Reproductive Biology below), in the Myrtoideae diversification at the species level has occurred predominantly through adaptation to different environmental conditions which mainly affect the physiology of the plant and the morphology of the vegetative parts, rather than through co-evolution with an array of pollinating or dispersing agents which alter flower and fruit morphology.

Furthermore, the aforementioned adaptation occurs not only as part of the speciation process but also intra-specifically. Thus cohabiting species tend to converge in the morphology of the vegetative parts through adaptation to the same environment. Differences in pubescence, for example, were much used to delimit species in the past. It has recently been shown (Stemmermann 1983) that pubescent varieties of two species of *Metrosideros* (Myrtaceae, Tribe Leptospermoideae) colonize new volcanic sites in Hawaii while the glabrous varieties occur in mature forest. In both species, the pubescent varieties maintained turgor at lower relative water content than the glabrous varieties, and the differences had a genetic basis. This suggests that pubescence is: a) probably under strong selective pressure related to water availability in the environment, and b) undergoing adaptation below the specific level. This fact is confirmed by the convergence of pubescence or lack thereof which I have observed amongst different species of Myrtaceae growing in the same habitat, such as the dense ferrugineous or rufous hairs that many species seem to have in the Serra do Cipó (Kawasaki 1989, personal observation) which are rare in the same species growing in forests. If we add to this evolutionary scenario the fact that the family is successful and widespread, e. g., the same species may exhibit several ecotypes, and that the floral morphology of a given species may be locally affected by the presence of other species of the Myrtoideae (usually a congeneric one) in its habitat (McVaugh 1958), the picture that emerges is that taxonomic criteria are extremely problematical.

Uniformity of flowers means pollinator-sharing, and pollinator-sharing may also mean sporadic hybridization through which an advantageous gene or new combination may spread into another species relatively quickly, making this

family an 'intra-cooperative' rather than an 'intra-competitive' one. The Myrtaceae are one of the largest families of Angiosperms in which the chromosome number is remarkably stable (X=11; Atchison 1947) and, at least in *Darwinia* and *Eucalyptus* (Myrtaceae, Tribe Leptospermoideae) natural hybridization is thought to be relatively widespread (Briggs 1964, Griffin et al. 1988). Hybrids have also been identified in genera of Tribe Myrtoideae such as *Myrceugenia,* in which three hybrids are found, two of which form hybrid swarms around lakes, Lago Nahuel Huapi in Argentina and Laguna Amargo in Chile (Landrum 1981). It was proposed by that author that the rather uncommon water balance around the lakes favours the hybrid above the parents.

This biological scenario, when coupled with several aspects of 19th century taxonomic practice, proved to have disastrous results. In dealing with wide-spread, generalistic species of Myrtaceae, the taxonomist is faced with the following dilemma: either to accept a large number of very different (although intergrading) specimens as comprising one highly polymorphic species, or to accept each specific ecotypical combination of characters as defining a species, thereby increasing the number of species in geometric progression. To 19th century monographers who possessed: 1) pre-evolutionary taxonomic concepts, 2) no field experience and, 3) a small sample of specimens, frequently collected on long journeys and thus from very different habitats, the former course was unacceptable. The result was that the same species was described repeatedly. Berg (1857, 1859), a German botanist who monographed the Myrtaceae for *Flora Brasiliensis,* was amongst the most prolific and described c. 1,000 new species over a period of seven years: modern revisions (Landrum 1981 , 1986) tend to put the vast majority of Berg species into synonymy. To complicate matters, Berg's types were deposited at Berlin and were destroyed during the second World War and duplicates (especially of Sellow collections) are not always easy to locate.

Prior to the *Flora Brasiliensis* itself, of special geographic pertinence to the Distrito Federal are the *Prodromus* of De Candolle (1828) and the *Flora Brasiliensis Meridionalis* of Cambessèdes (1833). In the *Prodromus,* new neotropical species of Myrtaceae were based mostly on Martius collections. Martius collected extensively in Minas Gerais, as well as in the Amazon, so many descriptions of cerrado species appeared at this time. The *Flora Brasiliensis Meridionalis* was based mostly on the Saint Hilaire, and a few Laroutte, collections from Minas Gerais, Goiás and Southern Brazil and

Uruguay. So by 1833, most of the commonest cerrado species had already been described. Cambessèdes had examined the Prodromus Herbarium (which contained fragments of Martius' collections) and therefore avoided redescribing species just published by De Candolle.

Berg's monumental account in Martius' *Flora Brasiliensis* (1857, 1859) was a very mixed blessing. At the generic level, it was a positive contribution as Berg was the first to delimit modern genera within Myrtaceae (McVaugh 1968). Unfortunately, at the species level he complicated the situation. The descriptions were excellent for the period, but we now know that Berg redescribed as new many De Candolle and Cambessèdes species, sometimes several times. The names of the latter author suffered especially as Berg had not seen the types and more or less described similar species at will and then added the Cambessèdes names, sometimes transferred to his new genera, but never citing any new material.

Berg's nomenclature also left much to be desired, even for the time, and many of his names are invalid under present rules. He apparently adopted the policy of complete freedom of the author to accept or reject prior names, and routinely changed names when remodelling taxa, e. g., he divided *Myrcia pubescens* DC. into three species and retained the epithet *pubescens* for none; he united *Eugenia bimarginata* DC. and *Eugenia umbellaris* DC. and cited them as synonyms under his own new *Eugenia dicrossa* Berg and then went on to create his own distinct but closely allied *Eugenia bimarginata* ! Although most De Candolle, Miquelis and Gardner names were maintained, Berg was inconsistent regarding names published in the *Flora Fluminensis* by Vellozo (1825). In doubtful new combinations, where he had not seen material, Berg used Vellozo epithets, e. g. *Gomidesia ? amplexicaulis* (Vell.) Berg, *Marlierea ? rufa* (Vell.) Berg. Where he had seen additional material that he believed to belong to the species, he would usually give it a new name, although citing the Vellozo name as a synonym, e. g. *Gomidesia chamissoeana* Berg which cites *Eugenia nitida* Vell. as a synonym. In some cases, Berg added the Vellozo synonym with a question mark. I have treated as illegal the Berg names for which the validly published Vellozo name is cited as a synonym without a question mark as illegal, while those that have a question mark after the synonym have been considered legal as these seem to indicate that Berg considered the species in question to be a possible synonym or perhaps that the protologue was insufficient to identify the species, e. g., *Plinia crocea* Vell. ? is

treated as a synonym of *Gomidesia jacquiniana* with the following comment added: *'Ico Velloziana supracitata maxime accedit ad hanc speciem, sed foliorum basis non plane quadrat'*. Another habit of Berg, irksome to a modern taxonomist, was that of attributing authorship in situations where *sensu* is now used. Thus '*Myrcia glauca* Miq. in *Linnaea* 22:534', cited by Berg as a synonym of *Aulomyrcia sphaerocarpa,* is a ficticious name for what would now be called *Myrcia glauca* Camb. *sensu* Miq., as Miquelis never intended to describe a new name and was merely identifying a specimen as *Myrcia glauca* Camb.

Several of the more widely distributed species were described quite early, such as *Myrcia tomentosa,* described as *Eugenia tomentosa* by Aublet (1775) or *Psidium guineense* described by Swartz (1788), respectively, from Guyana and Jamaica. Botanical exploration of South America began in the Caribbean and in Northern South America, so it is from these areas of the Neotropics that the commoner, wider-ranging species were first described. Up to the time of Amshoff and McVaugh, species from Northern South America were usually considered to be separate from the Brazilian species. Modern taxonomic work, which rests upon much larger (although by no means exhaustive) collections, has already shown a continuum of variation in some of these taxa, so that many names have fallen into synonymy. This is a tendency that will probably continue as more and more morphologically intermediate collections are made and the artificial species of the past break down.

Examples of this trend are the establishment of Humboldt, Bonpland & Kunth (1823) epithets for two widely-distributed species: *Blepharocalyx salicifolius* (HBK.) Berg and *Eugenia punicifolia* (HBK.) DC. These two taxa have recently been monographed, with a resulting list of 65 and 40 synonyms, respectively (Landrum 1986, Sobral 1987)!

1.1.2 Reproductive Biology

One of the consequences of the baffling taxonomy (and sheer numbers) of Neotropical Myrtaceae is that they are not usually chosen by non-taxonomic botanists as subjects of other kinds of investigation. Reproductive Biology is no exception and very little is known about the reproductive biology of Myrtaceae in the Neotropics. For Paleotropical and Australasian Myrtaceae there is more information available so a strong bias (especially towards Australia) will be evident in the following paragraphs.

A) Pollination

Pollination by bees is probably dominant in the family, with bird pollination the second most common kind. The Myrtaceae is believed to be one of several families with a history of 'faithful' bee pollination going back to the Paleocene (Crepet 1984). But pollination by most other pollen vectors has also been registered in a few species, as would be expected in such a large family.

Bee pollination occurs throughout the geographic range of the family: Costa Rica (*Eugenia salamensis* by *Ptiloglossa* sp., Colletidae; Frankie et al. 1983), Venezuela (*Eugenia* sp. visited by *Augochloropsis fulvofimbriata,* Halictidae, and by *Apis melifera* and *Trigona testiceicornis,* Apidae; Ruiz & Arroyo 1978), Indonesia (*Decaspermum parviflorum* by *Apis dorsata,* Apidae and *Nomia* spp., Halictidae; Kevan & Lack 1985) and possibly South Africa (*Eugenia* spp. visited by honeybees; Van Wyck & Lowrey 1988). In Australia the primitive, short-tongued Colletidae are very strongly associated with the Myrtaceae. Many of these bees are oligolectic within the family and visit whichever species happens to be in flower (Michener 1965) with *Angophora, Eucalyptus, Leptospermum* and *Melaleuca* being some of the most visited genera. Australian Myrtaceae are also visited by polylectic bees belonging to Colletidae and also by polylectic bees from other families such as Apidae, Anthophoridae, Halictidae and Megachilidae (Armstrong 1979).

Myrtaceous bee flowers are usually small (for the family) with many delicate, white or pink stamens and a sweet odor. Anthesis occurs before sunrise or shortly afterwards and the reward is either pollen, nectar or both (Armstrong 1979, Opler 1983, Kevan & Lack 1985, Van Wyck & Lowrey 1988).

Ford, Paton and Forde (1979) estimated that about 200 species of *Eucalyptus* (half the genus) as well as another 120 myrtaceous species of the genera *Beaufortia, Callistemon, Calothamnus, Darwinia* and *Regelia* are pollinated mainly by passerine birds (mostly Meliphagidae). Lorikeets (*Glossopsitta porphyrocephala,* Psittacidae) also visit several species of *Eucalyptus* but ensuing pollination is not proven (Churchill & Christensen 1970). In New Zealand, at least five species of *Metrosideros* are regularly visited by birds (Godley 1979).

Australasian bird pollinated Myrtaceae have large flowers or small flowers grouped in large pseudanthia with many stiff, red, yellow or white stamens, no odor or a strong, honeyed one (Ford, Paton & Forde 1979) and the hypanthium

prolonged above the ovary forming a cup. Nectar, which accumulates in this cup, is usually the floral reward, e. g. in *Eucalyptus, Callistemon, Calothamnus* (Ford, Paton & Forde 1979), *Metrosideros* (Godley 1979) and *Darwinia* (Briggs 1964). The bird-pollinated species of the latter genus have no hypanthial cups but the sepals and petals close tightly before nectar secretion starts.

Two small Neotropical genera, *Acca* and *Myrrhinum* also have stiff red stamens. Landrum (1986), who has recently revised them taxonomically, states that he has seen birds visiting cultivated plants of *Acca sellowiana* and there are several other such observations on cultivated plants of this species, e. g. by Kiaerskov (1893), Knuth (1906), McGregor (1976) and Vogel *et al.* (1984). In this species, however, the floral reward appears to be the petals which 'change color and become juicy and sweet as the anthers dehisce... there is no nectar' (Landrum 1986).

Bat pollination of several New Zealand species of *Metrosideros* seems highly likely, as pollen has been recovered from the fur of captured *Mystacina tuberulata* (Mystacinidae) by Daniel (1979). *Cynopterus* and *Pteropus* (Pteropodidae) visit some species of *Eucalyptus* , but can sometimes crush the flowers in the process (Faegri & Van der Pijl 1971). Pollination by marsupials (Phalangeridae) is suspected to occur in some Australasian Myrtaceae but remains unproven. *Tarsipes spencerae* visits flowers of *Beaufortia* (Morecombe 1968, Vose 1973), *Petaurus breviceps* visits flowers of *Melaleuca* and *Eucalyptus* (Sleumer 1955, Smith 1982) and *P. australis* visits flowers of *Eucalyptus* (Smith & Russell 1982). For both bats and marsupials, nectar is probably the main reward plus some pollen ingested while grooming.

Beetle pollination by large Scarabaeidae has been registered in *Angophora hispida* (Armstrong 1979), *A. woodsiana* (Hawkeswood 1981), *Eucalyptus fecundus* and *E. cylindriflora* (Hawkeswood 1982). The latter two species of *Eucalyptus* are also visited by jewel-beetles, Buprestidae (Hawkeswood 1982) and these beetles pollinate *Melaleuca pauperiflora* as well (Hawkeswood 1980). A possible adaptation to beetle pollination is the thickened torus between the staminal disk and the ovary present in *A. hispida.*

Bee flies (Bombyliidae, Diptera) have also been observed to feed on the nectar of tube-flowered *Calytrix longifolia* but it is not clear if this results in pollination (Armstrong 1979).

Finally, some species appear to have mixed pollination systems.

Leptospermum scoparium is visited by flies, bees and moths at different times of the day in its native montane New Zealand habitat (Primack 1978) and Hawaiian *Metrosideros collina* is an interesting example of a species with two floral morphs, a red-flowered one which predominates at higher altitudes and is more frequently bird pollinated and a yellow-flowered one which predominates at lower altitudes and is more frequently insect pollinated (Carpenter 1976).

B) Flowering phenology

The flowering strategies adopted by Myrtaceae seem to vary considerably. Herbarium and informal field observations by Van Wyck & Lowrey (1988) suggest that in South Africa most species of *Eugenia* have a locally synchronized flowering season in spring, with two species flowering in summer and one in winter. In shrubby, rhizomatous *E. albanensis* flowering is promoted by burning.

In Costa Rica, *Eugenia oerstediana* and *Psidium guineense* (both dry forest shrubs) flower several times a year in synchronized flowering episodes lasting less than two weeks. In *P. guineense,* most of the flowers are produced in the two flowering episodes that occur in the dry season; fruits are to be found all year but are dispersed mainly at the end of the wet season (Suaréz & Esquivel 1987). *Psidium guajava* (a wet forest tree) also flowers in short synchronized episodes twice a year. *E. oerstediana* matures its fruit in about two months while both *Psidium* species take about four to five months (Opler, Frankie & Baker 1980). *E. salamensis* (a dry forest tree) flowers once a year in a synchronized, flowering episode lasting less than two weeks (Frankie et al. 1983). In Venezuela a deciduous forest species of *Eugenia* flowers in the beginning of the wet season (Ruiz & Arroyo 1978).

In the Amazon, a phenological study of five sympatric species of Myrtaceae (Ferreira & Merona 1987) revealed that none of the species flowered in late wet season and none produced fruits in the four driest months (precipitation below 150 mm per month). Otherwise, reproductive activity was staggered through the year in the following manner: *Myrcia grandis, Myrcia paivae* and *Myrcia* sp. flowered more or less synchronously at the beginning of the wet season (Nov-Dec-Jan, Oct-Nov-Dec-Jan and Oct-Nov-Dec respectively) and matured their fruit over the next 4 months in late wet season. *Myrciaria floribunda* flowered in the middle of the wet season (Jan-Feb) and matured its fruit over the next 2 months, also in late wet season. *Marlierea spruceana* flowered in the dry

season (Jun-Jul-Ago-Set) and matured its fruit over the next three months in early wet season.

In Chile and southern Brazil, most species of *Myrceugenia* (a cool, wet forest genus) flower during summer or autumn and then slowly mature their fruit over the next 9-12 months thereby presenting fruit to dispersers in the summer/autumn period of the next year (Landrum 1981). A few species of *Myrceugenia* flower in late winter, spring or early summer and then mature their fruit fairly rapidly (in 1-5 months) in time for the summer/autumn period of the same year. A similar pattern was observed in *Calycorectes sellowianus, Campomanesia guazumaefolia* and *Myrcia rostrata* which grow together in the mountains of southeastern Brazil. They flower in spring to early summer (early to mid- wet season) and mature their fruits 2-3 months later in mid- to late summer (Morellato & al. 1989).

C) Breeding Systems

Species of Myrtaceae have structurally hermaphrodite flowers and until quite recently were presumed to be functionally hermaphrodite. There is a growing body of evidence, however, that this is not always so. Andromonoecism and dioecism have been registered for the family wherever careful investigations have been carried out.

1) Andromonoecism - This was first registered in *Eucalyptus calophylla* by Carr, Carr & Ross (1971) and these authors believe it may also occur in other species of *Eucalyptus* section *Corymbosae,* e. g. *E. filicifolia, E. intermaedia,* etc. It has also been more recently found in *E. petraea* which belongs to section *Adnataria* (Carr & Carr 1983). The male flowers differ from the hermaphrodites by their short, slender styles and smaller, undifferentiated ovules and underdeveloped oil ducts; the shape of the flowers may differ also. Male flowers may either occur isolated within a predominantly hermaphrodite inflorescence or compose a whole male inflorescence and occasional all male trees can sometimes be found. Judging from Barlow & Forrester's (1984) account of several species of *Melaleuca,* this type also occurs in that genus with the additional information that the stigmatic papillae of the male flowers are smaller and pollen will not germinate on them.

In a detailed investigation of monoecism in *Leptospermum scoparium,* Primack & Lloyd (1980) found that the male flowers lacked pistils and weighed

about half as much as the hermaphrodites. Hermaphrodite flowers accounted for 0-43 % of the flowers of a given plant (Mean = 7.3% [1977] and Mean = 3.7% [1978]). Hermaphrodite flowers were more frequent in upper branches and in terminal positions and tended to open in the first flush of flowering. The percentage of hermaphrodite flowers produced by a plant increased with nutrient treatments suggesting that in this species, at least, monoecism is primarily a mechanism adjusting maternal reproductive investment to immediate physiological conditions. Carr & Carr (1983) observed an all-male tree of *E. petraea* and found that it remained so for three years, which caused them to state that the percentage of male flowers probably did not vary significantly from year to year for a given individual.

2) Dioecism - The 'cryptic dioecism' of allspice, Caribbean *Pimenta dioica,* was first described in detail by Chapman (1964). Judging from descriptions in the literature, this condition also occurs in Indonesian *Decaspermum parviflorum* (Kevan & Lack 1985) and in all the South African species of *Eugenia* (Van Wyck & Lowrey 1988). Male plants produce only male flowers that have a reduced pistil and a larger number of stamens with fertile pollen. Female plants produce only female flowers with a normal pistil and fewer stamens that produce sterile pollen. It is interesting that the epithet *dioica* was chosen for this species by Linnaeus, probably due to the reduced number of stamens in the female flowers which had great importance in his sexual system.

Lloyd (1982) predicted that in plants which offer pollen as main reward to the pollinator dioecism would only be favoured over co-sexuality (hermaphroditism + monoecism) if female flowers mimicked the males. This is exactly what happens in the dioecious Myrtaceae: dioecious species retain stamens and produce pollen, albeit inviable. There is some variation, however, in the degree of sterility of the pistils of the male flowers and how the sterility of pollen is attained in the female flowers.

Thus in *Pimenta dioica* sexual dimorphism is quite subtle: pistils of male flowers are morphologically normal but usually sterile, although one-seeded fruits occasionally develop (fruits from female flowers are two-seeded); pollen grains from the stamens of female flowers are morphologically normal but show negligible *in vitro* germination. In the South African *Eugenia* species sexual dimorphism is stronger: male-flower pistils are rudimentary or absent

and female-flower pollen is morphologically abnormal, e. g., spheroidal and atreme or colpate. In Indonesian *Decaspermum parviflorum,* male-flower pistils are also absent and female-flower pollen is unstainable and collapsed.

There are reports of underdeveloped styles and abortive ovaries in taxonomic descriptions of *Pimenta guatemalensis* (Landrum 1986) and several species of *Calyptranthes* , e. g. *C. fasciculata* Berg (Berg 1857, Amshoff 1942), *C. longifolia* Berg and *C. speciosa* Sagot (McVaugh 1958) but these are based on limited material and must be viewed with caution. It should be noted, however, that such cryptic dioecism as exhibited by allspice could be quite common. It was only discovered in allspice because, as a crop plant, the barren male trees attracted the attention of farmers which led to the investigation by Chapman (1964).

Barlow & Forrester (1984) found sexual dimorphism in 80% of the *Melaleuca* species they investigated. If this figure holds true for the rest of that genus, one can conservatively estimate that some 250 species of Myrtaceae, or 5% of the family, have some form of sexual dimorphism.

In the truly hermaphroditic Myrtaceae, total self-incompatibility has been found in Australian *Melaleuca* (Barlow & Forrester 1984), in a Venezuelan species of *Eugenia* (Sobrevila & Arroyo 1982) and in *Psidium sartorianum* (Bullock 1985). Partial self-incompatibility, characterized by reduced seed-set when selfed, has been registered in Hawaiian *Metrosideros collina* (Carpenter 1976), in Venezuelan *Myrcia fallax* (Sobrevila & Arroyo 1982), in Australian *Eucalyptus regnans* (Sedgley & al. 1989) and in several species of *Darwinia* (Briggs 1964). A possible gametophytic control was suggested for *Melaleuca* by the aforementioned authors as pollen tubes in selfed pistils are arrested or become disoriented at the base of the style and do not penetrate the ovules. In *Eucalyptus regnans* no differences in ovule penetration or early embryology were observed between self- and cross-pollinations up to 16 weeks (Sedgley & al. 1989) which led the authors to affirm that reduced seed-set after selfing must be due to a post-zygotic phenomenon such as inbreeding depression. In *Eucalyptus woodwardii,* however, there was reduced penetration of ovules following self-pollinations as compared to cross-pollinations (Sedgley & Smith 1989) but some selfed seed was set.

Darwinia is probably the best studied genus in the family (Briggs 1964) with regard to breeding systems and natural hybridization patterns. The completely

self-compatible species of this genus seem to be typical inbreeders (e.g., small green flowers, no visitation, high fruit-set and a very precise mechanism for self-pollen deposit on the receptive stigma as the style elongates). These selfing species almost never hybridize among themselves or with outcrossing species. The partially self-incompatible species of *Darwinia* are typical outcrossers with showy bird-pollinated flowers and a style that elongates before the pollen is released. They were found to hybridize between themselves provided the seed parent had a comparable or shorter style than the pollen parent. But this could not be explained by supposing that the pollen tubes of the short-styled species were incapable of traversing the longer styles: short-styled species' pollen tubes grew down the styles and penetrated the ovules of long-styled species in crosses which later proved infertile. Furthermore, there was no relationship between general morphological similarity and the hybridization pattern within the genus *Darwinia*. Thus two very similar, sympatric species were not known to hybridize, while two very different ones hybridized readily wherever their distribution ranges overlapped.

1.1.3 Economic Importance

The most economically important Myrtaceae in Brazil are Australian *Eucalyptus* spp. planted for timber, paper, cellulose and essential oils. *Eucalyptus* in Brazil grows much faster than in its native country. Where there are *Eucalyptus* plantations, native Myrtaceae can function as reservoirs of insect parasites such as larvae of *Eacles, Hylesia, Eupseudosoma, Nystalea, Sarsina* and *Thyrinteina* (Lepidoptera) and fungal diseases such as *Puccinia psidii* (Anjos & Alves 1988, unpubl.). Native Myrtaceae are not planted for timber due to their slow growth rate.

The most important cultivated myrtaceous fruit tree in Brazil is *Psidium guajava* L. (guava). Guavas are exported and can be found in Brazil year-around in the large supermarkets as fresh fruit, jams, and various canned sweets. Other myrtaceous fruits are also commercialized but mostly on a smaller scale in local markets and fruit stalls when in season. The most well known are *Psidium* spp. (Araçá), *Eugenia uniflora* L. (Pitanga), *Plinia glomerata* L. (Cambucá), *Myrciaria cauliflora* (DC.) Berg (Jaboticaba), *Myrcianthes pungens* (Berg) Legr. (Guabijú), *Campomanesia* spp. (Guabiroba), *Eugenia myrcianthes* Nied. (Pêssego-do-mato,

Cereja-do-Rio-Grande, Ivaí) and *Eugenia pyriformis* Camb. (Uvaia) but there is a lot of local variation. In the cerrados region the fruits of *Eugenia dysenterica* DC. (Cagaita), *Campomanesia velutina* Berg and *C. aromatica* (Guabiroba) are consumed by the local people but rarely commercialized. Myrtaceous fruits are reported to have a high vitamin C content (Pechnik & Guimarães 1962). Exotic *Syzygium caryophyllatum* (L.) DC. (cloves) and *Pimenta dioica* L. (allspice) are also planted for the food industry.

Because of their high tannin and essential oil content, Myrtaceae were much used in the popular medicine of the past, mostly where an adstringent or cleansing agent was required, e. g., as teas made of the leaves or bark for treating sore throats and wounds or taken internally for diarrhoea. Some species have been studied scientifically and found to be effective such as the essential oil of *Callistemon viminalis* which is used against helminthic parasites (Garg & Kasera 1983).

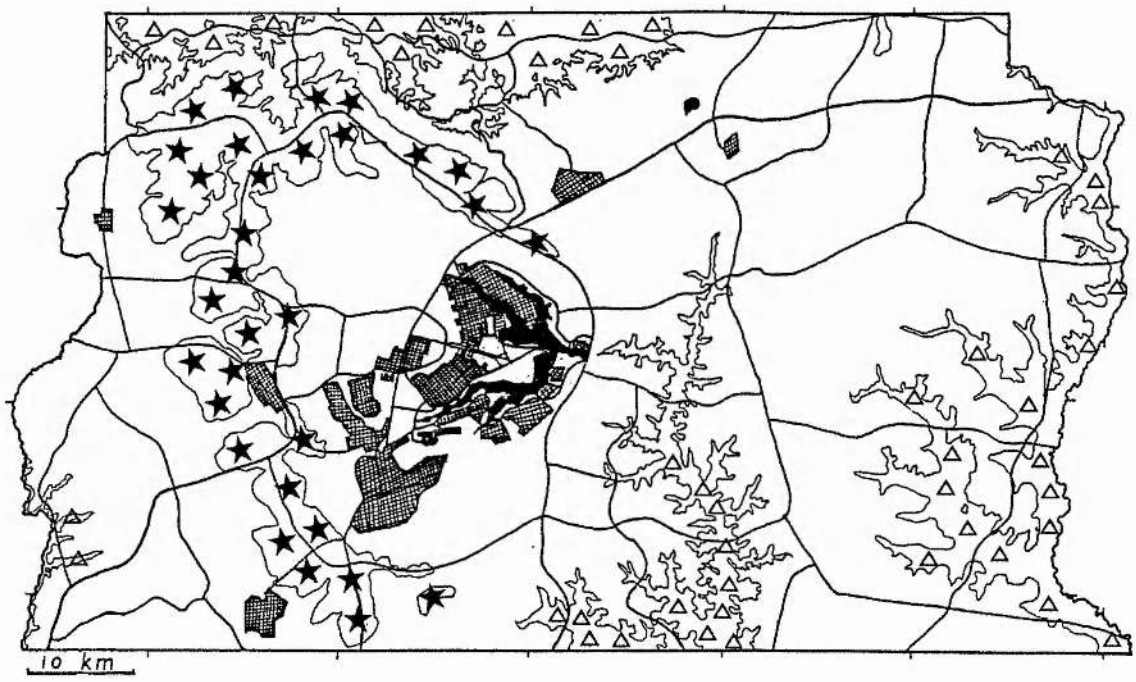
1.2 The Distrito Federal

1.2.1 General Information

The Distrito Federal is a rectangle of c. 5800 m^2 surrounding the capital city of Brazil, Brasília. Brasília was planned and built in the 1950's and has been the capital of the country since 1960. It is encapsulated within the State of Goiás with one of its corners touching the border of Minas Gerais. The area was selected for its central position in an effort to bring prosperity inland, since almost all Brazil's large cities are close to the coast, with the country's interior much less developed. It is situated aproximately between 47° 20' - 48° 20' longitude and 15° 30' - 16° 00' latitude.

Altitudes vary from c. 750 to 1350 m. s. m. and Eiten (1984) describes it geologically as an ancient pediplain with a topology of flattish plateaus sloping gently or steeply to narrow or wide river valleys, the underlaying rocks being mostly slate and sandstone with some quartz, quartzite, limestone and others (Fig. 1.1).

Fig. 1. 1 - Distrito Federal (Urban Areas, Roads and Altitude)



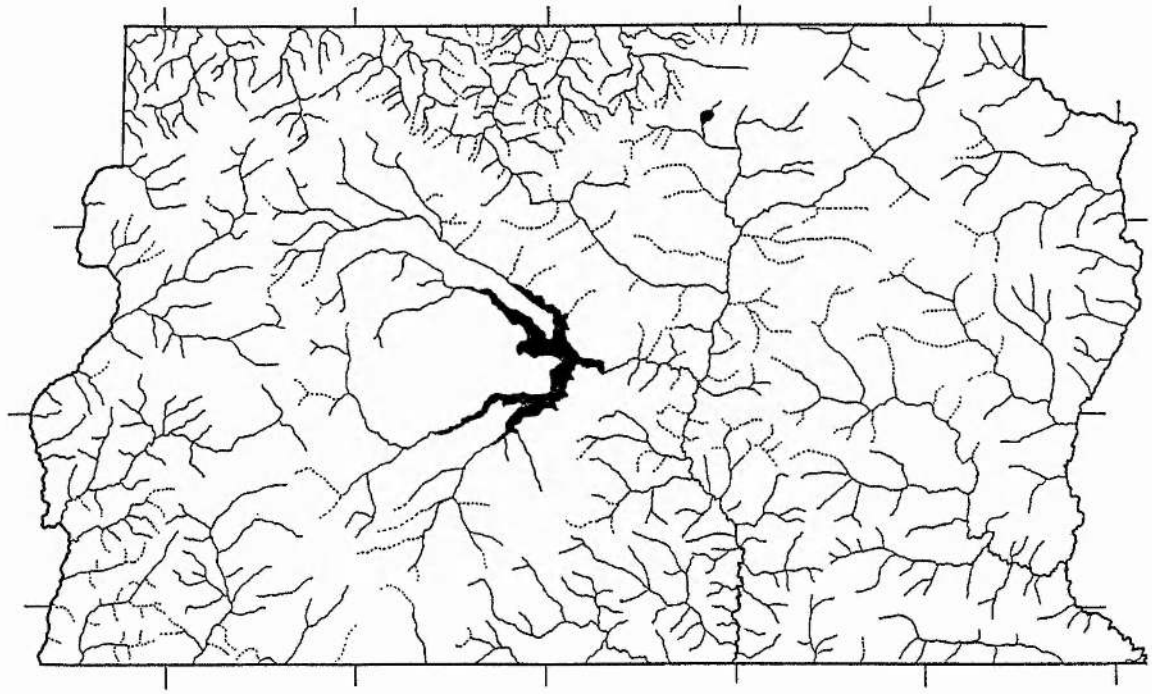
Urban Areas

★ Above 1200 m s m

△ Below 800 m s m

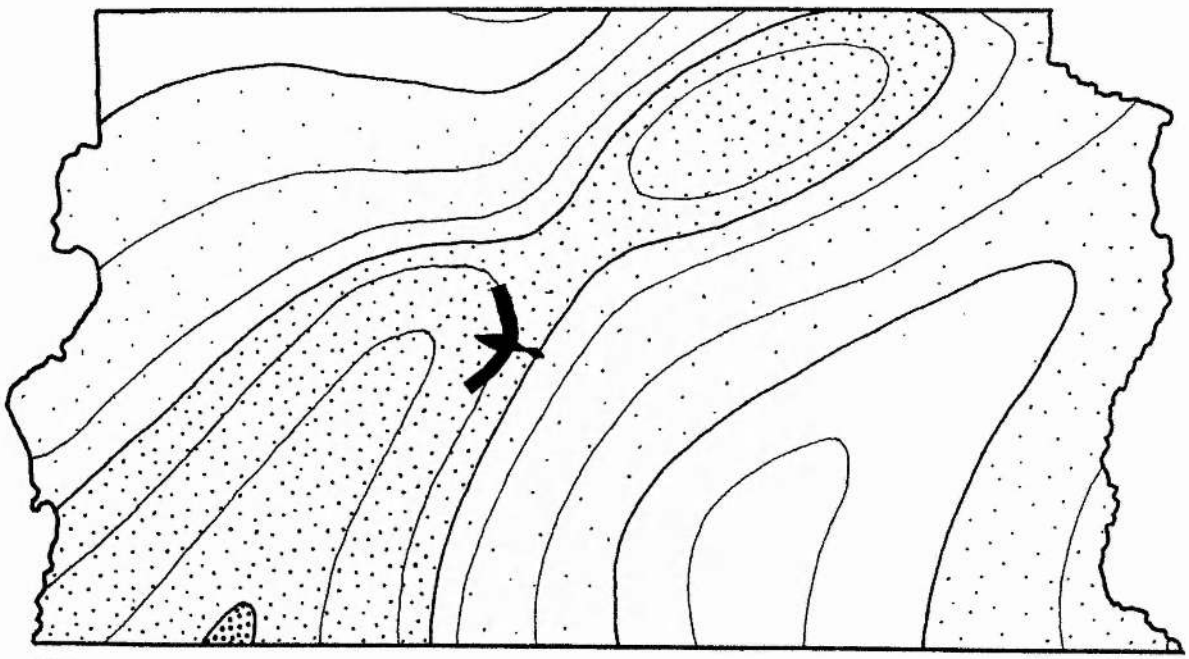
There are basically four large rivers within the Distrito Federal boundaries. These are interesting in that two of them (Descoberto and São Bartolomeu) drain southwards into the Plate Basin, the third (Maranhão) drains northwards into the Amazon basin and the fourth (Preto) runs northeastwards into the São Francisco Basin (Fig. 1.2). Thus, this relatively small area is a watershed with tributaries of the three most important South American river basins. There are three large lakes within the Distrito Federal, two of them artificial (Lago Paranoá and Lagoa Santa Maria) and one natural (Lagoa Bonita).

Fig. 1. 2 - Distrito Federal (Rivers)



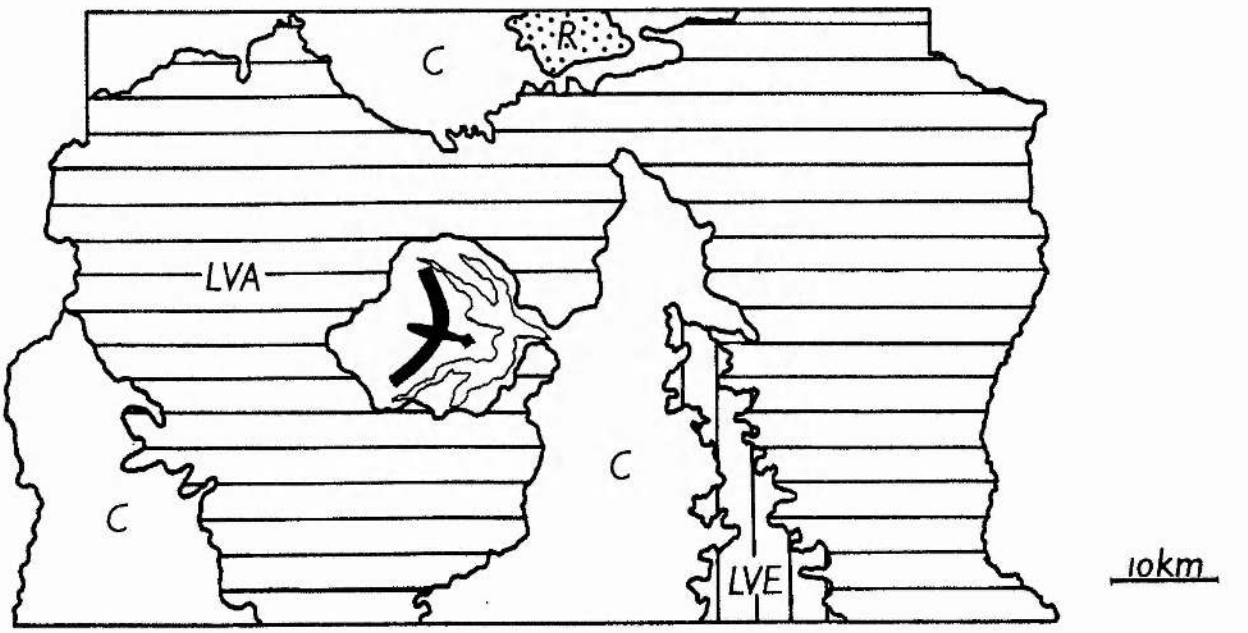
Through most of the Distrito Federal the climate is Köppen's (1946) Aw type 'tropical with a single dry season in winter' (A = mean temperature of the coldest month above 18° C and mean temperature of the hottest month above 22° C; w = mean rainfall per year above 850 mm and mean rainfall of the driest month below 60 mm). At higher altitudes the mean temperature of the coldest month falls below 18° C which changes the classification to Cw (Monte & al. 1984, unpbl. data). Annual rainfall varies between 1340-1600 mm per year, with a diagonal band of higher rainfall crossing the Distrito Federal from north-east to south-west (Fig. 1.3).

Fig. 1. 3 - Distrito Federal (Annual Isohyets)



The soils may be very deep (to 50 m) to quite shallow or even absent on steep slopes. Most of the soils are infertile but with excellent drainage properties, e. g., a high proportion of either sand or flocculated clay. According to Haridasan (1990) the most common types of soils in the Distrito Federal (c. 54 %) are nutrient-poor, highly acidic red and yellow latosols which occur mostly on the highlands (Fig. 1.4). Cambisols (c. 31 %) of varying levels of pH and fertility occur in the areas cut by river basins. To the northwest of the Distrito there is a region of limestone outcrops with a small central area of 'terra roxa' nitosols (c. 1 %) with relatively high levels of calcium and magnesium (but not phosphorous) and the cambisols from this area also are only weakly acidic and more fertile than those from other parts of the Distrito Federal. Sites of impeded drainage on flat valley bottoms are occupied by hydromorphic soils (c. 5 %) and there are a few areas of quartzsoils (c. 1%).

Fig. 1. 4 - Distrito Federal (Soil types)



LVA = Yellow-red latosol

LVE = Red latosol

C = Cambisol

R = Nitosol

1.2.2 Phytogeography and Phytophysiognomies

Phytogeographically, the Distrito Federal is in the core of the *cerrados* province. This province occupies c. 23% of Brazilian territory (Furley & Ratter 1988) and is composed of a species-rich, fire-adapted form of savanna which is cut by gallery forests and marshes in the valleys where water is more abundant (Fig. 1.5).

Fig. 1. 5 Distribution of Cerrados and Savannas in Brazil

According to Eiten (1984) there are nine different types of vegetation physiognomies within the Distrito Federal. These are sumarized below:

1) *Cerrado*

This is by far the most common in the Distrito Federal. *Cerrado* vegetation is a mosaic and varies from a 10-15 m tall savanna woodland in which the canopy is nearly closed and grasses are excluded, to a low, open grassland with no woody plants at all. All possible intermediate stages occur but the most common is the *cerrado sensu stricto* which is a semi-open form with twisted shrubs and corky-barked trees between 2-8 m tall and a substantial herbaceous layer of grasses, herbs and subshrubs.

The traditional subdivisions of cerrado have been accepted by most authors, e. g. Eiten (1979), Goodland & Ferri (1979), Ratter (1976), Ribeiro *et al.*(1983) and these names will be used from here on (listed from the most closed to the most open):

cerradão (tall savanna woodland);
cerrado denso (savanna woodland, the trees quite dense);
cerrado sensu stricto (savanna woodland);
cerrado ralo (savanna woodland, the trees sparse);
campo cerrado (shrubby grassland, literally field-savanna);
campo sujo (field with scattered shrubs, literally 'dirty field');
campo limpo (grassland, literally 'clean field').

Furley & Ratter (1988), Furley *et al.* 1988 and Ratter *et al.* (1973) also recognize two floristic variants in cerradão, the mesotrophic cerradão on richer soils and the dystrophic cerradão on poorer soils. The former intergrades with mesophytic forests and the latter with gallery forests (Ratter unpubl. data).

Although cerrado vegetation has many adaptations to fire, the repeated occurrence of fire in an area will act to transform the vegetation into one of the more open types, while prolonged lack of fire will cause the vegetation to close and shade out the herbaceous layer (Coutinho 1978, Ratter & al. 1988 b). But the height and openness of cerrado vegetation is also influenced by the fertility (especially level of phosphorous) and by the depth of the soil. Another factor is the depth at which a layer of lateritic pebbles may occur - if this layer is less that

2 m deep it will progressively stunt the growth of the trees and open the vegetation as it comes closer to the surface (Eiten 1984).

2) Gallery forest [further divided into inundated, swampy and headwaters gallery forest by Ratter (1986)]

This is a forest 10-30 m tall which grows along the rivers. Swampy gallery forest can be quite inpenetrable and is easily recognizable by the pale, emergent crowns of *Xylopia emarginata* which is one of the commonest species of this kind of vegetation, other common species are *Calophyllum brasiliense, Clusia* sp., and a tree fern, *Cyathea* sp. The commonest gallery forest is of the dry kind and the tree composition varies considerably from place to place (Eiten 1984).

3) Upland mesophytic evergreen forest on latosol ['Mata mesofítica de interflúvio' of Azevedo et al. (1990)]

A common kind of vegetation in Minas Gerais and São Paulo, this is found in only two places in the Distrito Federal (Eiten 1984), and is probably brought about by a fortunate coincidence of soil and microclimate. The largest, most well-known one occurs at c. 1150 m. s. m. with rainfall above 1400 mm per year, although many other areas have these same characteristics and yet have cerrado or cerradão. Floristically it combines gallery forest and cerradão elements, with certain species that are rather uncommon in both finding ideal conditions here, such as *Pimenta pseudocaryophyllus* (Myrtaceae), *Cheiloclinum cognatum* (Hippocrateaceae) and several species of *Miconia* (Melastomataceae).

4) Upland mesophytic forest on limestone ['Mata de Calcáreo']

This is a 10-15 m tall forest which is characterized by its calciphilous species, including an *Attelea* palm and a *Cereus* cactus (Eiten 1984); it can be either evergreen, semi-deciduous or completely deciduous depending upon the depth of the soil (Eiten 1984). In a phytosociological survey the most important species were *Eugenia florida, Metrodorea pubescens, Piptadenia inaequalis* and two unidentified species of *Aspidosperma* and *Alibertia;* the most important families were, in this order, Leguminosae, Myrtaceae, Rubiaceae, Apocynaceae, Sapindaceae, Combretaceae, Euphorbiaceae, Moraceae and Rutaceae (Ramos 1989).

5) Seasonal marsh

This is a strip of low grassy vegetation which occurs on certain wet valley sides between the cerrado and the gallery forest where the topology of the terrain causes the seasonal fluctuation of the water table to occur near the surface. The flora is made up of *Xyris, Drosera, Selaginella* and other characteristic species which do not occur in cerrado; the change from cerrado to seasonal marsh may be either abrupt or gradual depending upon topology (Eiten 1984).

6) Permanent marsh

This is similar to seasonal marsh except that it occurs in lower, flatter places where the water does not drain even in the dry season. In the wet season such marshes may become small ponds. They are characterized by species of *Xyris, Ludwigia,* etc.

7) 'Vereda' marsh

This is characterized by vegetation similar to seasonal marsh but dotted with *Mauritia flexuosa* palm trees.

8) Campos de murundús

Slightly elevated islands of cerrado vegetation dot these seasonally wet fields. It is not known if the origin of the islands is mechanical, through erosion or biological through termite activity. The species that occur on the top of the islands, such as *Curatella americana* (Dilleniaceae), *Byrsonima crassifolia* (Malpighiaceae) and others, are the cerrado species which are most tolerant of periodic flooding (Furley & Ratter 1988).

9) Aquatic vegetation

This occurs in Lagoa Bonita, the only natural lake within the DF.

1.2.3 History of Botanical Exploration within the Distrito Federal

Emmanuel Pohl, an Austrian botanist, was probably the first to collect in what is now the Distrito Federal, specifically between Santa Luzia (where he spent the Christmas of 1818) and the São Bartolomeu River (Urban 1906). Auguste de Saint Hilaire and George Gardner may also have passed within or

at least fairly close to the Distrito Federal, respectively in 1826 and 1838. At the turn of the century Antoine Glaziou also collected within the Distrito Federal, between the Torto, Bananal and Gama Rivers, and in nearby Goiás in Santa Luzia (now Luziânia) and Saia Velha. Several of his 'nomina nuda' (Glaziou 1908) are from the region, such as *Eugenia gameana, E. coriacea, Myrcia gameana, M. angustifolia, M. kierskowii, M. rigida* and *M. kiaerskowiana.* Since the construction of the city of Brasília and the political demarcation of the Distrito Federal, Ezequias Heringer has unquestionably been its most important collector. Heringer came to Brasília from Paraopeba, Minas Gerais in 1961, soon after the new capital was founded. Roughly a quarter of the Distrito Federal material here studied are either Heringer, or after 1980, Heringer and co-workers collections, the most notable of the latter being Benedito Pereira, Roberta Mendonça and Tarciso Filgueiras. James Ratter of the Royal Botanic Gardens at Edinburgh, Howard Irwin of the New York Botanical Garden and Joseph Kirkbride Jr., currently at United States Department of Agriculture have also collected extensively within the Distrito Federal, and the two former collectors also in the cerrados region in general.

1.2.4 Floristics and Origin

According to a recent but rather preliminary listing based on present herbarium determinations there are c. 120 families and c. 1700 species of native Angiosperms in the Distrito Federal (Filgueiras & Pereira 1990). Number of species per family is as follows (the number of Myrtaceae has been corrected):

Table 1.1 - Families of Angiosperms in the Distrito Federal

FAMILIES	NUMBER OF SPECIES
1. Leguminosae	253
2. Compositae	170
3. Gramineae	127
4. Rubiaceae	76
5. Euphorbiaceae, Myrtaceae	65
6. Melastomataceae	58
7. Orchidaceae	53
8. Malpighiaceae	46
9. Cyperaceae	40

FAMILIES	NUMBER OF SPECIES
10. Labiatae	39
11. Bignoniaceae	36
12. Apocynaceae, Verbenaceae	35
13. Malvaceae	29
14. Convolvulaceae	27
15. Lauraceae, Solanaceae	23
16. Polygalaceae	22
17. Loranthaceae	19
18. Palmae, Sapindaceae	18
19. Bombacaeae, Lythraceae	17
20. Eriocaulaceae	16
21. Moraceae	14
22. Iridaceae, Guttiferae, Piperaceae, Vochysiaceae	13
23. Bromeliaceae, Oxalidaceae	12
24. Boraginaceae, Hippocrateaceae, Myrsinaceae	11
25. Chrysobalanaceae, Cucurbitaceae, Meliaceae	10
26. Gentianaceae, Sterculiaceae, Tiliaceae	9
27. Commelinaceae, Dilleniaceae, Erythroxylaceae, Ochnaceae, Passifloraceae	8
28. Rhamnaceae, Turneraceae, Xyridaceae	7
29. Umbelliferae	6
30. Burmaniaceae, Cactaceae, Combretaceae, Flacourtiaceae, Gesneriaceae, Menispermaceae, Nyctaginaceae, Onagraceae, Polygonaceae, Rutaceae, Scrophulariaceae, Smilacaceae, Symplocaceae, Velloziaceae, Vitaceae	5
31. Burseraceae, Celastraceae, Loganiaceae, Zingiberaceae	4
32. Aristolochiaceae, Connaraceae, Maranthaceae, Pontederiaceae, Proteaceae, Rosaceae, Simaroubaceae, Styracaceae	3
33. Caparidaceae, Caryophyllaceae, Cunnoniaceae, Dioscoreaceae, Ebenaceae, Ericaceae, Humiriaceae, Lacistemaceae, Lecythidaceae, Liliaceae, Monimiaceae, Musacaeae, Myristicaceae, Oleaceae,	

FAMILIES	NUMBER OF SPECIES
Ulmaceae, Violaceae	2
32. Balanophoraceae, Bixaceae, Caricaceae, Caryocaraceae, Chloranthaceae, Cochlospermaceae, Dichapetalaceae, Droseraceae, Elaeocarpaceae, Hypoxidaceae, Icacinaceae, Juncaceae, Krameriaceae, Lentibulariaceae, Lobeliaceae, Magnoliaceae, Marcgraviaceae, Mayacaceae, Mendonciaceae, Olacaceae, Opiliaceae, Phytolacaceae, Ranunculaceae, Rapateaceae, Trigoniaceae, Typhaceae, Urticaceae, Winteraceae	1

Gentry (1982) assigned a hypothetical origin to the American families of plants, mostly based upon their present centres of diversity. If his categories are accepted, then the following picture for the flora of the Distrito Federal (which can probably be extrapolated for the core cerrados area) emerges: 37 % are Northern Gondwanan, 26 % are Southern Gondwanan, 20 % are Laurasian and 3 % Dry Gondwanan; 14% of the families were unassignable.

At the species level this majority sequence is accentuated and 49 % of the species belong to Northern Gondwanan families as compared to 41 % to Southern Gondwanan families and 9 % to Laurasian families (which frequently have only 1-2 species in the Distrito Federal).

1.2.5 Ecology

The tree and large shrub stratum of 'cerrado senso lato' vegetation in the Distrito Federal has been rather well studied in recent years and it is possible to estimate the ecologically dominant families. Table 1.2 is a compilation of data from 12 phytosociological studies of which 4 are cerrado sensu stricto, 1 is dense cerrado, 2 sparse cerrado and 5 cerradão communities. Families occurring in the ten first positions are listed with their IVI rankings in each community. A mean importance value was then calculated by adding up the inverses of the rankings. Thus, a species ranking first in one community, second in another and third in yet another would have a mean dominance of 1 + 1/2 + 1/3 = 1.83. If a family was present below the 10th position it was rated with a + sign and assigned a token value of 0.05 (equivalent to c. 19/20th position). This was done because low

rankings would tend to be more strongly affected by variation in methodologies such as minimum girth, level of measurement, etc. Final values were rounded to one decimal point to avoid arbitrary rankings based on aproximation.

This ranking shows that ecologically also the Northern Gondwanan families dominate the tree and large shrub stratum in cerrado. Seventeen Amazon-centered families account for c. 66 % of the mean dominance value and these are, in order of importance, the Leguminosae, Vochysiaceae, Icacinaceae, Caryocaraceae, Apocynaceae, Malpighiaceae, Ochnaceae, Lauraceae, Annonaceae, Palmae, Bignoniaceae, Sapindaceae, Loganiaceae, Combretaceae, Anacardiaceae, Simaroubaceae and Euphorbiaceae. The Southern Gondwanan families are the next most important element and 9 families account for c. 27 % of mean dominance and these are the Myrtaceae, Guttiferae, Rubiaceae, Melastomataceae, Araliaceae, Proteaceae, Compositae, Nyctaginaceae and Monimiaceae. A single Dry Gondwanan family, Erythroxylaceae, is responsible for c. 2 % of mean dominance value and two Laurasian families, the Styracaceae and the Lythraceae, jointly comprise c. 5 % of mean dominance.

1.3 Importance of the Myrtaceous element in the Distrito Federal

Species of the Myrtaceae can occur in all forms of Distrito Federal cerrados and forests, as trees up to 15 m tall to subshrubs c. 10 cm tall. The Myrtaceae tie with Euphorbiaceae for the 5th place as well represented families in number of species. In mean dominance of tree and large shrub stratum of cerrado vegetation, the family ranked third. Biogeographically, it is probably not an exaggeration to state that the Myrtaceae are the most successful Southern Gondwanan family in the Distrito Federal. Clearly, the Myrtaceae are an important family by any standards.

Table 1.3 is a compilation of phytosociological data for Myrtaceae within various phytophysiognomies in the Distrito Federal. The highest Importance Value rankings for the family occurred in dystrophic cerradão. This is due mostly to the great importance of two species, *Blepharocalyx salicifolius* and *Siphoneugena densiflora* which are indicators of such vegetation (Furley & Ratter 1988). Roughly speaking, the family's importance in this stratum then diminishes to a vanishing point as the cerrado becomes more open, whilst increasing in the subshrub stratum.

Table 1.2 - Ecologically dominant families in the tree and large shrub stratum of Distrito Federal cerrado

	Family	Σ (1 / IVI rank)	IVI Ranks in the Communities *											
			1	2	3	4	5	6	7	8	9	10	11	12
1	Leguminosae	7.4	3	2	1	2	2	2	2	1	5	1	3	1
2	Vochysiaceae	6.7	1	1	4	1	4	1	1	2	3	5	1	8
3	Myrtaceae	3.6	2	+	2	5	+	5	10	3	4	9	-	-
4	Icacinaceae	2.4	+	-	3	-	1	-	-	+	1	-	-	-
5	Guttiferae	1.7	4	8	+	3	+	9	6	+	-	+	2	10
6	Rubiaceae	1.5	+	9	+	10	7	10	+	+	-	2	+	4
7	Caryocaraceae	1.4	+	5	9	8	+	4	4	8	10	+	+	+
7	Styracaceae	1.4	6	+	-	9	-	3	+	+	-	-	10	2
9	Apocynaceae	1.2	8	+	8	7	+	+	8	4	10	+	-	6
9	Malpighiaceae	1.2	10	4	+	-	-	+	7	7	9	7	+	5
9	Ochnaceae	1.2	+	3	+	+	+	8	3	+	-	-	-	9
9	Melastomataceae	1.2	7	7	+	6	5	+	9	10	7	-	-	+
13	Lauraceae	1.1	9	-	7	-	3	-	-	+	2	-	-	-
13	Compositae	1.1	+	10	+	+	-	+	+	9	+	-	4	3
15	Proteaceae	.9	+	+	10	+	+	+	5	+	8	+	6	-
15	Erythroxylaceae	.9	+	6	+	+	+	+	+	+	-	+	7	7
17	Araliaceae	.8	+	+	5	+	-	7	+	6	+	-	+	-
18	Nyctaginaceae	.7	+	+	+	+	9	6	-	+	6	-	-	-
19	Lythraceae	.6	+	+	+	+	+	+	+	+	-	-	5	-
20	Annonaceae	.5	-	+	-	4	+	+	-	+	+	-	9	-
20	Palmae	.5	-	-	-	+	+	-	+	5	8	-	-	-
20	Bignoniaceae	.5	+	+	+	+	+	-	-	+	-	+	8	-
23	Sapindaceae	.4	-	-	-	-	+	-	-	-	-	3	-	-
24	Loganiaceae	.35	5	+	-	+	-	-	-	+	-	-	-	-
25	Combretaceae	.3	-	-	-	+	-	-	-	-	-	4	-	-
25	Anacardiaceae	.3	-	-	+	-	+	-	-	-	-	6	-	-
25	Simaroubaceae	.3	-	-	6	-	+	-	-	+	-	-	-	-
25	Euphorbiaceae	.3	-	-	+	-	6	-	-	+	-	-	-	-
29	Monimiaceae	.15	-	-	-	-	10	-	+	-	-	-	-	-

* Details and references in Table 1.3

Quantative studies of the herbs and subshrub layer are almost non-existant but one account (Azevedo & al. 1990) cites *Myrcia* sp. as one of the most important with 1.1% of Cover Value in a campo limpo site where all the other important species were grasses; the importance of the family as a whole is unfortunately impossible to calculate as data is presented only for the most important species. Field experience confirms that Myrtaceae are a relatively important component of the herb and subshrub layer in campo sujo and campo limpo communities, the represented genera being *Myrcia, Psidium, Eugenia* and *Campomanesia.* Some of these cerrado subshrubs may be among the last to be excluded in the seasonal marshes and also occur on the campos de murundus, probably due to their greater flood tolerance.

In the mesophytic forest on latosol studied, Myrtaceae was also quite important in the arboreal stratum (4th place) while in the mesophytic forest on limestone the family ranked 2nd. High rankings on rich soil are rather rare for Myrtaceae (see Chapter 3) but analyses of the soils of this forest showed that although it had higher pH, calcium and magnesium than the soils of surrounding cerrado areas, phosphorous levels were about the same.

Gallery forests varied considerably with regard to the Myrtaceous component (from 4th place to absent). Some of this variation is undoubtedly due to the individual characteristics of each forest, e. g., inundated, swampy or dry, but even among similar dry-type gallery forests the flora can vary quite a lot (Eiten 1984). An artificial factor introduced is probably due to the different methods used: IVI's increased as smaller qualifying diameters were set, e. g., 5 cm at 30 cm from the ground > 5 cm DBH > 8 cm DBH > 20 cm DBH (where the family was absent). This would be expected in a family whose members are mostly small trees (Ferreira & Merona 1987) in the lower layers of forests (Assumpção & al. 1982, Martins 1979). The gallery forest is the habitat where the family is most diverse, however, and c. 60 % of the Distrito Federal species occurr in this form of vegetation. As a result Myrtaceae frequently ranks high in relative diversity within gallery forests, e. g. in a species-poor inundated forest the family was a low 13th in IVI but tied for 1st place in diversity with 3 species (Ratter 1976).

Table 1. 3 - Ecological importance of Myrtaceae in several kinds of Distrito Federal phytophysiognomies (trees and large shrubs only)

Phytophysiognomy	Method	IVI or VI		Species		Reference
		Rank	**%**	**No.**	**%**	
Cerradão	PCQ (10H)	**1st**	17.1	**2**	3.6	Ratter 1976
Cerradão (3)	PCQ (5Ft)	**2nd**	16.1	**4**	6.7	Felfili & Silva Jr. 1990
Limestone forest	PLT (5Ft)	**2nd**	4.5	**6**	5.8	Ramos 1989
Cerrado denso (1)	PCQ (10H)	**2nd**	11.8	**2**	3.8	Azevedo & al. 1990
Cerradão (8)	PLT (3H/2)	**3rd**	10.8	**4**	7.3	Ratter 1976
Mesophitic forest	PCQ (10H)	**4th**	10.5	**2**	5.6	Azevedo & al. 1990
Gallery forest	PCQ (5Ft)	**4th**	5.3	**5**	6.2	Felfili & Silva Jr. 1990
Cerrado s. s. (6)	PCQ (10H)	**5th**	5.6	**2**	5.4	Azevedo & al. 1990
Cerrado s. s. (4)	PLT (3H/2)	**5th**	4.6	**4**	6.1	Ribeiro & al. 1985
Dystr. cerradão (9)	PCQ (10H/2)	**5th**	12.3	**1**	2.6	Haridasan & Araújo 1988
Mesotr. cerradão (10)*	PCQ (10H/2)	**9th**	2.3	**2**	5.1	Haridasan & Araújo 1988
Cerrado s. s. (7)	PLT (3H/2)	**10th**	2.7	**1**	2.0	Ratter 1976
Dystr. cerradão (5)	PCQ (3H/2)	**13th**	2.9	**3**	3.7	Ribeiro & al. 1985
Inundated forest	PCQ (5H)	**13th**	1.9	**3**	8.4	Ratter 1976
Gallery forest	PCQ (5H)	**14th**	2.9	**5**	4.8	Felfili & Silva Jr. 1990
Swampy forest	PCQ (5H)	**15th**	1.5	**2**	6.7	Ratter 1976
Cerrado s. s. (2)	PCQ (5ft)	**18th**	1.0	**3**	4.9	Felfili & Silva Jr. 1990
Cerrado s. s.	PCQ (TS)	**20th**	2.1	**1**	2.4	Barbosa 1983
Headwaters forest	PLT (8H)	**21st**	0.7	**1**	2.7	Ratter 1976
Gallery forest	PCQ (20H)	-	0	**0**	-	Azevedo & al. 1990
Cerrado ralo (12)	PCQ (10H)	-	0	**0**	-	Azevedo & al. 1990
Cerrado ralo (11)	PCQ (3H/2)	-	0	**0**	-	Ribeiro & al.1985

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* 150 km N of the Distrito Federal

PCQ = Point Center Quarter (Cottam & Curtis 1956)

PLT = Plots

(T S) 'trees and shrubs'

(numbers in brackets refer to the communities in Table 1.2)

(20 H) > 20 cm DBH (diameter 130 cm above ground)

(10 ft) > 10 cm diameter 1 ft above ground

(10 H) > 10 cm DBH

(8 H) > 8 cm DBH

(5 H) > 5 cm DBH

(5 ft) > 5 cm diameter 1 ft above ground

(3ft/ 2) > 3 cm diameter 1 ft above ground or > 2 m tall

CHAPTER 2 - REPRODUCTIVE BIOLOGY

2.1 Methods

Field work was carried out at the Reserva Biológica do Jardim Botânico de Brasília. All plants studied were native, wild Myrtaceae. A group of eight species (Table 2.1), belonging to six genera and native to different habitats (Fig. 2.1) were investigated. The following aspects were considered: (1) flowering strategies and reproductive success, (2) floral biology and (3) breeding systems.

Table 2.1 - Species Investigated for Reproductive Biology

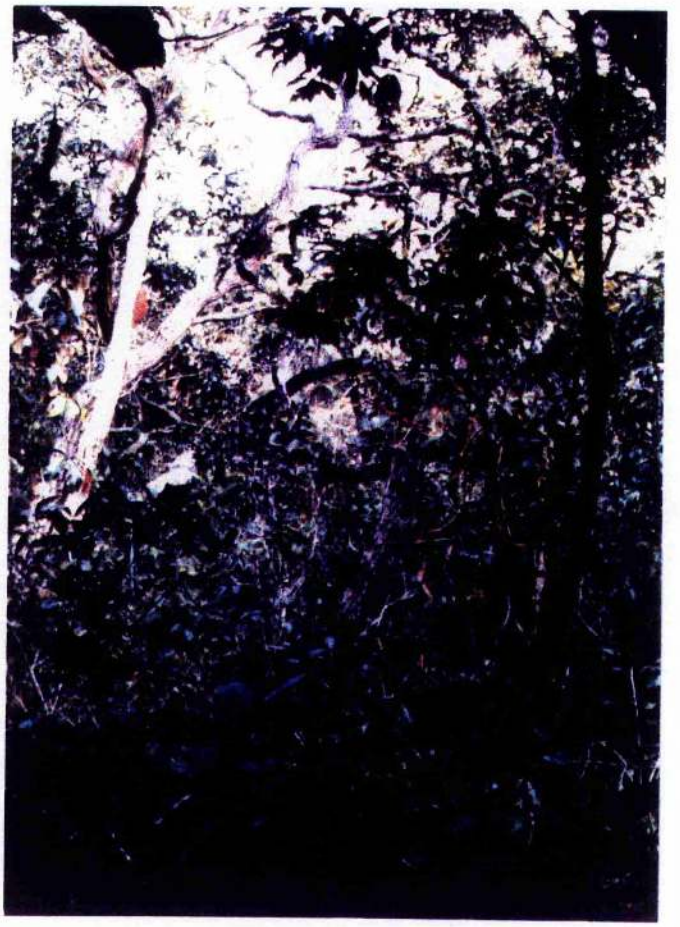
Subtribe	Species	Habitat (Fig. 2.1)
Eugeniinae	*Eugenia dysenterica*	dense cerrado
	Siphoneugena densiflora	dense cerrado
Myrciinae	*Myrcia linearifolia*	campo sujo
	M. rhodosepala	campo sujo
Myrtiinae	*Blepharocalyx salicifolius*	dense cerrado
	Campomanesia pubescens	campo sujo
	C. velutina	gallery forest fringe
	Psidium firmum	campo sujo

1) Flowering Strategy and Reproductive Success

Two to ten plants were chosen and enough young inflorescences per plant marked to yield at least 100 buds. Inflorescences with no open flowers were chosen and tagged by attaching pieces of coloured plastic-coated wire to the stems.

In the case of *Myrcia rhodosepala* and *Psidium firmum,* all inflorescences on a shrub were marked so that graphs of daily flower production represent the whole flowering episode for the shrubs in question. For trees such as *Eugenia dysenterica, Siphoneugena densiflora, Blepharocalyx salicifolius* and

Fig. 2. 1 - General appearence of two of the study areas



Dense

cerrado

Campo

sujo

Campomanesia velutina it was not possible to mark all inflorescences, so the actual flowering episode for the tree sometimes lasted slightly longer than that depicted in the graph.

This also occurred with *C. pubescens,* a shrub composed of a clump of aerial shoots of various ages. Different-aged shoots flowered at different periods so it was not always feasible to monitor an individual's whole flowering episode but rather that of a subsample of inflorescences. The numbers of buds and flowers present on each inflorescence were monitored on a daily basis until the day that the last flower opened. Weekly observations were then maintained until the first fruit appeared mature.

2) Floral Biology

Each species was observed for 1-3 observation periods lasting from 15 minutes to 3 hours to establish the identity of the probable pollinator. The earliest observation period started at 4:00 a. m. and the latest ended at 11:00 a. m. Except for *Campomanesia pubescens* and *Blepharocalyx salicifolius,* in which anthesis was not observed, at least one of the observation periods started at anthesis. Visitors were captured with a standard entomological net. An asterisk (*) after visitors names indicate that they were captured and later identified by a specialist, while no asterisk means a tentative identification by myself in the field.

Descriptions of the flowers were based on field obvservations and on herbarium specimens from the Distrito Federal. The term compitum is used for open spaces linking individual locules in the ovaries (Carr & Carr 1961).

3) Breeding Systems

Several inflorescences were marked and bagged with nylon bags with a 2-mm mesh. Bags were tied at the base of the inflorescence with a thick string that was threaded through the mesh. Bagged inflorescences were monitored until anthesis occurred, when the remaining unopened buds were removed, the number of open flowers counted and one of the following treatments applied:

1) Automatic self-pollination (left with no further treatment)
2) Self-pollination (done by hand)
3) Cross-pollination (done by hand)

Flowers were not emasculated. Hand pollinations was done by brushing a dehisced anther against the stigma and were always carried out in the morning. In the self-pollinations, the anther was taken from the same flower. In the cross-pollinations, the anther was removed from a recently collected flower belonging to another plant. Cross-pollinations were always done between plants growing at least 50 m away from each other except for two of the three*Campomanesia velutina* trees which were c. 10 m apart.

Subsamples of each of these treatments were collected c. 24, 48 and 72 hours after pollination (or reclosing of the bags for the automatic self-pollination inflorescences) and fixed in 70% ethanol. Fixed flowers were susequently used to check pollen grain germination and pollen tube growth by means of fluorescence microscopy. The hypanthium and staminal disk were cut away from the pistil which was then softened for 10-20 minutes with 8 M NaOH at 60 ^{o} C and stained with 0.1% leuco-aniline blue in 0.1 N K_3PO_4 (Martin 1959) with traces of calcofluor white as a fluorescence enhancer. Preparations were observed with a Leitz Laborlux 12 Microscope fitted with Ploemopak 2.5 fluorescence vertical illuminator and appropriate ultra-violet filter.

The number of pollen tubes in the style and of ovules being penetrated by pollen tubes were counted. For penetrated ovules per flower the significance of the results between control self-pollinations and hand self-pollinations and between hand self- and cross-pollinations were statistically evaluated using Student's t-test. Flowers which had insect-damaged stigmas, styles or ovules were excluded in calculation of means. The number of pollen tubes were not analysed statistically as they were estimates only. Illustrative preparations were photographed using a Pentax camera back and Ilford FH 4, ASA 125, black and white film. For some species, pistils were embedded in wax following standard tertiary-butanol dehydration and infiltration (Johansen 1940), sectioned with a Reichert Ultracut Microtome and the sections stained with leuco-aniline blue with a trace of calcofluor white.

The remaining flowers were left to set fruit and were monitored on a weekly basis until the first fruit matured. Such inflorescences were unbagged 1-2 weeks after anthesis. In a few cases the fruit was collected and the seeds and embryos examined.

In order to quantify and compare the species among themselves we chose two parameters: PERS (Pre-emergent Reproductive Success; Wiens 1984) and IAS (Index of Automatic Self-pollination; Ruiz & Arroyo 1978).

PERS is an estimate of female reproductive success, namely the percentage of ovules that form embryos in a given reproductive episode. PERS is believed to be heavily influenced by breeding system, with inbreeders having a high PERS and outbreeders a low one (Wiens 1984). For *Campomanesia pubescens,* PERS was calculated as natural fruit-set (%) x nº of seeds / nº of ovules (found in n=9 flowers and fruit from the population studied). As the number of seeds was not counted except in *Campomanesia pubescens,* a probable PERS range was established for the other species in the following way: **between** natural fruit set (%) x minimum nº of seeds / maximum nº of ovules **and** natural fruit set (%) x maximum nº of seeds / minimum nº of ovules (found in at least 3 flowers and fruits collected in the Distrito Federal).

IAS is a ratio that estimates the comparable success of automatic selfing and vector-mediated selfing (actually by the botanist but in theory by the pollinator). IAS was calculated as automatic self-pollination fruit-set (%) / hand self-pollination fruit-set (%).

2.2 Results and Discussion

2.2.1 *Eugenia dysenterica* Mart. ex DC.

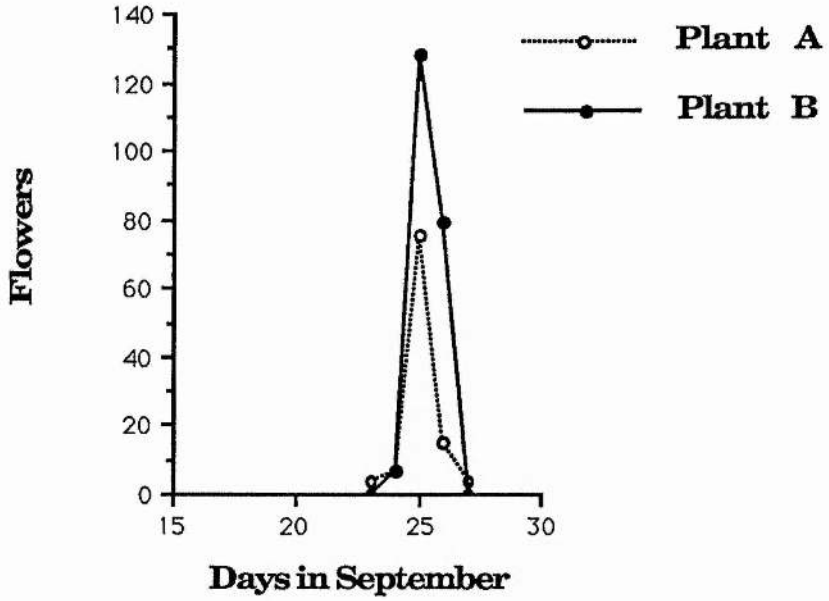
This species is a relatively common cerrado tree up to about 10 m. A large tree may produce many thousands of flowers. The inflorescence is a so-called 'precocious' raceme that appears slightly before the new leaf crop thus making the flowers more conspicuous. Flowers have a sweet smell and no nectar. The flowers are c. 1.5 cm with c. 60-70 stamens and 2-4 ovules in each of the 2 locules. Petals and stamens are white. The style is straight and the stigma is dry and raised c. 1-2 mm above the stamens.

E. dysenterica flowers in late dry to early wet season (September). The trees I monitored were in flower for about 1 week (Fig. 2.2) but my informal

observations suggest a flowering period of about 3-4 weeks for the species as a whole in the Distrito Federal.

Anthesis occurs around 6:30 (daybreak at 6:00). Sepals and petals open simultaneously and expose the style amidst a cluster of anthers which space out as the crumpled filaments expand. Anthers open a few minutes later, as soon as the flowers become completely dry.

Fig. 2.2 - Daily flower production in two *Eugenia dysenterica* trees



This species is a highly attractive one and is visited by a wide variety of insects. During my daily morning visits it was not possible to ascertain the identity of a principal pollinator (see also Table 2.22 for precise observation periods). *Trigona spinipes, Trigona* sp. (Trigonidae), *Bombus* sp. (Apidae), *Ceratina gossypii* (Anthophoridae) and other unidentified bees visited the flowers with at least occasional stigmatic contact. No bees were observed to effect buzz-pollination in this species. *E. dysenterica* was also intensely visited by a very small bee probably belonging to the Meliponinae and a variety of beetles, wasps, flies and hornets that were not observed to contact the stigma. Most visits last from anthesis to about 10:30 a. m. but occasional visitors were observed all

through the day.

Fruit-set results are presented in Table 2.2 and fruit-set success curve in Fig. 2.3. Eighty-eight percent (88.37 %) of the buds produced flowers. Massive flower abortion occurred in the two weeks following pollination after which the retained ovaries started to swell. Some ovaries were retained in all three treatments. Differences in fruit-set between self- and cross-pollinations were not statistically significant ($t_{0.95}$ =0.049; v = 28) nor were those between self- and automatic self-pollinations ($t_{0.95}$ =0.835; v = 31). Seeds resulting from experimental pollinations were examined and found to have apparently healthy embryos. This was the quickest reproductive cycle registered. The PERS range is between 0.57 % and 4.56 % and the IAS is 0.43.

Fig. 2.3 - Fruit-set success curve for *Eugenia dysenterica*

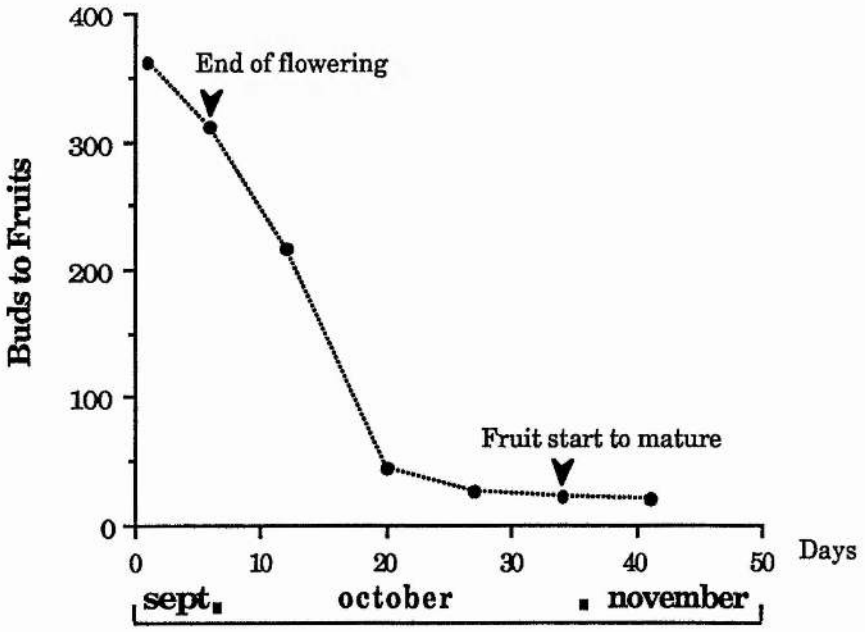


Table 2.2 - Fruit-set results from experimental and natural pollination of *Eugenia dysenterica*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self-pollination	1	14	1	**7.14 %**
Self pollination	1	18	3	**16.67 %**
Cross pollination	2	15	3	**20.00 %**
Natural	2	325	22	**6.77 %**

Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.3.

Table 2.3 - Fluorescence microscopy data on fixed subsamples of *Eugenia dysenterica*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	**6 / 1** **8 / 1**	**0 / 0** **2 / 0**	**?**
Self-pollination	**0 / 0** **±5 / 0**	**0 / 0** **0 / 0** **5 / 1** **6 / 1** **6 / 1** **7 / 1** **5 / 3**	**±5 / 2** **?* / 1**
Cross-pollination	**1/ 0** **±15 / 0**	**5 / 0** **6 / 1**	**±5 / 0**

* style abscissed

In ovaries fixed at 24 hours the self-pollinations and cross-pollinations had no ovule penetrations; it was not possible to ascertain if the mean number of penetrated ovules observed in the automatic self-pollinations (mean=2) differed significantly from 0 (t=1/0; v=2).

In ovaries fixed at 48 hours the mean number of ovule penetrations in the cross-pollinations (mean=0.5) did not differ significantly ($t_{0.95}$ =0.73; v = 8) from that of the self-pollinations (mean=1); the mean number of penetrated ovules observed in the self-pollinations (mean=1) did not differ significantly ($t_{0.95}$ =1.55; v = 8) from that of the automatic self-pollinations (mean=0).

In ovaries fixed at 72 hours no penetrated ovules were observed in the cross-pollinations; the mean number of penetrated ovules in the self-pollinations (mean=1.5) did not differ significantly ($t_{0.95}$ = 1.22; v = 1) from 0.

Discussion

Eugenia dysenterica appears to be self-compatible. The low PERS range, however, does not suggest habitual inbreeding but quite the opposite. Cross-pollination must be a rather uncommon event for a species so intensely visited by such a wide range of unspecialized visitors, including many pollen thieves such as the two species of *Trigona* and the minute Meliponinae. The synchronicity of the 'big bang' (sensu Gentry 1974) flowering strategy is probably responsible for a significant amount of any outcrossing that may occur.

2.2.2 *Siphoneugena densiflora* Berg

This species is a cerradão or gallery forest tree up to 12 m. A tree may produce from a few hundred to several thousand flowers. The inflorescence is a very contracted axillary raceme with 1-14 flowers (mean= 7.14 flowers per inflorescence; n=42 inflorescences on 2 trees). Flowers have a sweet smell and no nectar. The flowers are 5-8 mm with 65-110 stamens and 3-6 ovules in each of the 2-3 locules. Petals and stamens are white. The style is straight and the stigma is dry and raised c. 1-2 mm above the stamens. The locules are connected to the conducting tissue by compita which open up at the same level in the middle of each placenta (Fig. 2.7 A).

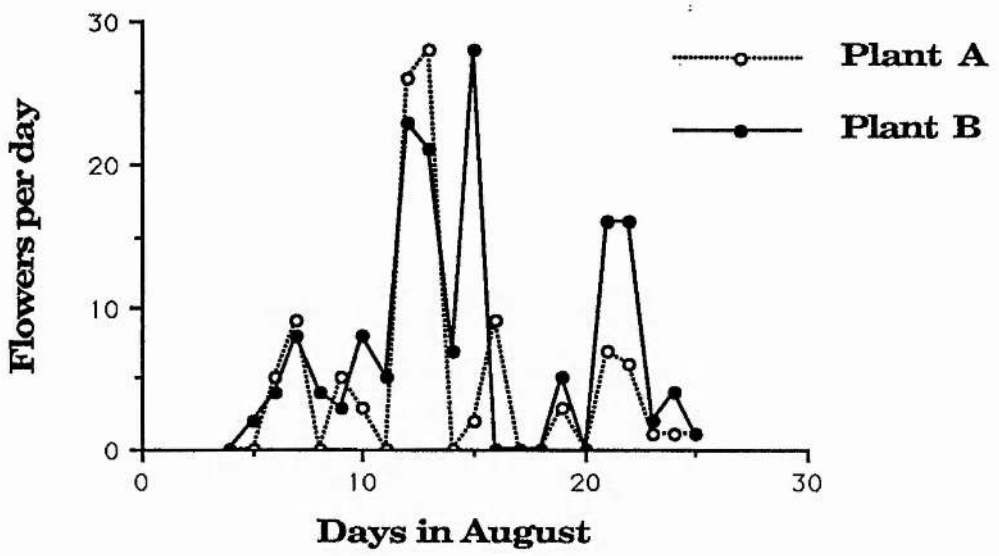
Flowering usually occurs in mid to late dry season (August and September).

The two trees studied flowered for c. 4 weeks but my informal observations suggest a flowering period of about 8 weeks for the species as a whole. Flowers do not open every single day but there was a loose synchronicity between the two trees monitored (Fig. 2.4). Inflorescences which opened flowers at all averaged 1.84 flowers per day (n=137 observations).

Anthesis occurs between 3:00 and 4:00 a. m. (daybreak at 6:00). Sepals and petals open simultaneously and expose a tight bundle of incurved stamens and style. The style is usually the first to straighten itself and protrude above the bundle. The stamens then slowly unfurl starting with the outermost. The flower starts to give off a faint scent. Anthers do not dehisce until daybreak.

The presumptive pollinator is a *Ptiloglossa* sp. (Colletidae) which arrives at 6:00 (daybreak). The bee alights on a flower, bunches up the style and many stamens with all its legs, buzzes, rises and alights on another flower of another inflorescence. The first arrival was observed to test a few flowers and then hover about for a few minutes, perhaps waiting for the anthers to dehisce. Visits to each flower are very brief and last about 1 second. Five bees were observed to visit one tree in 60 minutes of observation and two bees to visit another tree in 30 minutes of observation (both periods starting at 6:00 - see also Table 2.22). The last visit I recorded was at 6:45 and these bees probably do not visit this species much later than this. Introduced *Apis mellifera* will also visit this species but their visits start later, around 6:30 and continue until 9:30. The *Apis mellifera* bees are incapable of buzz-pollination and walk over the stamens collecting pollen, occasionally contacting the stigma. Their visits take about 3 seconds per flower. Other visitors were small wasps and minute pollen-eating beetles that do not contact the stigma.

Fig. 2.4 - Daily flower production of two *Siphoneugena densiflora* trees



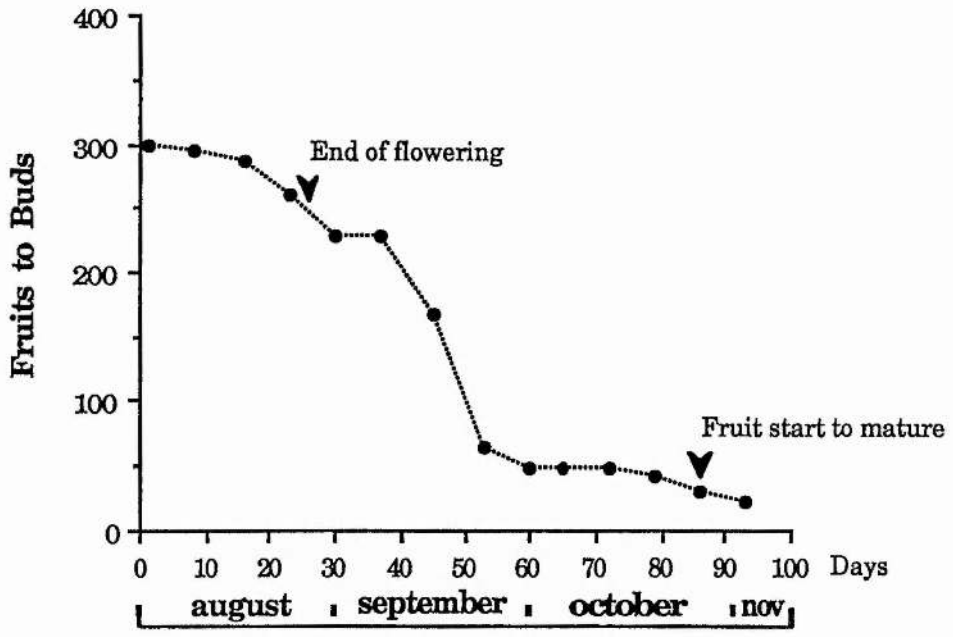
Most pollen grains removed from a captured specimen of *Ptiloglossa* sp. appeared to be identical to that of *S. densiflora*.. Another larger grain, very probably also myrtaceous, was also encountered in lesser numbers.

Fruit-set results are presented in Table 2.4 and the fruit-set success curve in Fig. 2.5. Eighty-one percent (81.33 %) of the buds produced flowers. All control self-pollinated and hand self-pollinated flowers aborted between the 4th and 5th week after anthesis but 58.33 % of the hand cross-pollinated flowers went on to set fruit. Hypanthial cups abscised 2-3 weeks in all the flowers that went on to set fruit and in most of those that later aborted. Young ovaries were retained virtually unchanged on the tree until about the 11th week after anthesis when they began to redden and swell and in another two weeks the first fruits matured. The trees produced 0.50 fruits per inflorescence (n=42) but the mean number of fruits per fruit-bearing inflorescence was 2.13 (n=23). The PERS is expected to be between 0.85 and 4.75 and the IAS is null.

Table 2.4 - Fruit-set results from experimental and natural pollination of *Siphoneugena densiflora*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self-pollination	2	56	0	0 %
Self-pollination	2	17	0	0 %
Cross-pollination	3	36	21	58.33 %
Natural	2	244	31	12.75 %

Fig. 2.5 - Fruit-set success curve for *Siphoneugena densiflora*



Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.5.

Table 2.5 - Fluorescence microscopy data on fixed subsamples of *Siphoneugena densiflora*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	1 / **0**	3 / **0**	11+ / **0**
	11+ / **0**	6-10 / **0**	11+ / **0**
Self-pollination	0 / **0**	3-5 / **0**	11+ / **0**
	6-10 / **0**	6-10 / **0**	11+ / **0**
	6-10 / **0**	6-10 / **0**	11+ / **0**
	6-10 / **0**	11+ / **0**	11+ / **1**
	11+ / **0**		
Cross-pollination	0 / **0**	2 / **0**	6-10 / **0**
	3-5 / **0**	6-10 / **0**	6-10 / **0**
	6-10 / **0**	6-10 / **0**	6-10 / **1**
	11+ / **0**	6-10 / **0**	11+ / **0**
		6-10 / **1**	11+ / **0**

Ovaries fixed at 24 hours had no ovule penetrations regardless of treatment.

Ovaries fixed at 48 hours had no ovule penetrations for control self-pollinations and self-pollinations; the mean number of penetrations in the cross-pollinations (mean=0.17) did not differ significantly ($t_{0.95} = 0.82$; $v = 8$) from that of the self-pollinations (mean=0).

Ovaries fixed at 72 hours had no ovule penetrations in the automatic self-pollinations; the mean number of penetrations in the self-pollinations (mean=0.25) did not differ significantly ($t_{0.95} = 0.58$; $v = 4$) from that in the automatic self-pollinations (mean=0); the mean number of penetrations in the self-pollinations (mean=0.25) did not differ significantly ($t_{0.95} = 0.13$; $v = 7$) from that in the cross-pollinations (mean=0.2).

Discussion

Although fruit-set indicates that the species is completely self-incompatible, self-pollen tubes penetrating ovules and embryo sacs were observed (Fig. 2.17 G) in self- as well as cross-pollinations. No significant difference in the number of ovule-penetrations were observed per treatment up to 72 hours. The abortion of

selfed ovaries only ocurred 4-5 weeks after pollination, which is a much longer period than that observed in other taxa with late-acting self-incompatibility type phenomena (Peter Gibbs, personal communication).

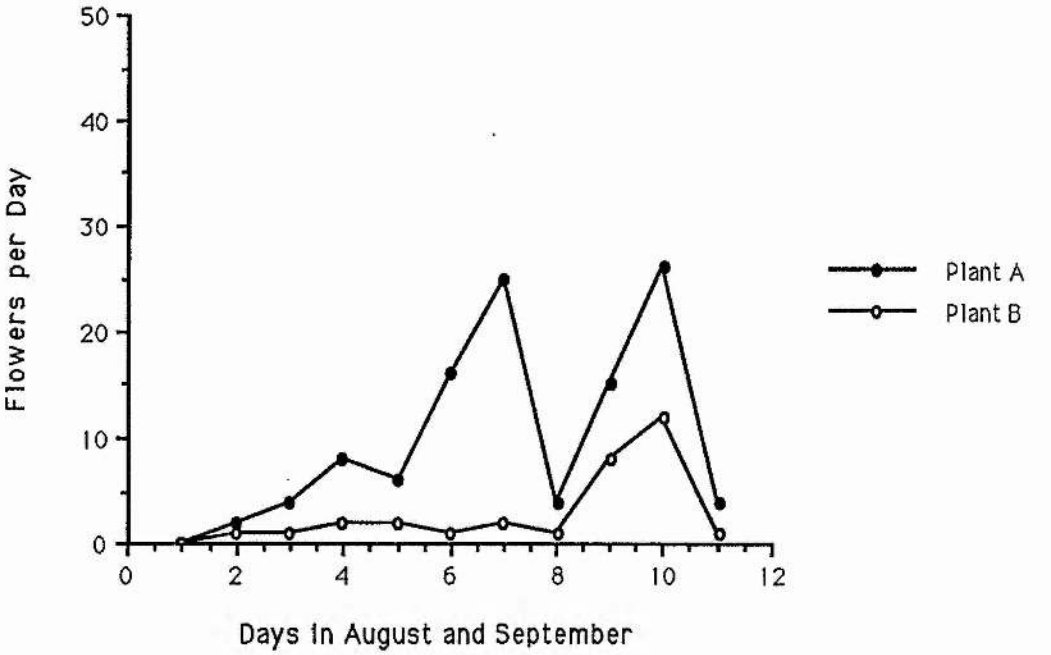
The pollinator's foraging strategy of only visiting one flower per inflorescence, even if other flowers of that inflorescence are open, correlates with the fact that the mean number of open flowers per inflorescence is only 1.84. This presumably makes for more efficient foraging in the long run.

2.2.3 *Myrcia linearifolia* Camb.

This is a vaccinioid shrub which is quite common in the Distrito Federal in campo sujo and in the more open types of cerrado. *M. lineariflolia* flowers in late dry season to early wet season and flowering lasts c. 12 weeks. An individual plant is in flower for about two weeks. Intra-populational synchronization of flowering is not very fine-tuned but as the flowering period is extended and the population large, there are always several shrubs in flower (Fig. 2.6).

One shrub can produce from about 30 to 800 flowers. The inflorescence is a thyrsoid, terminal panicle. Flowers have a sweet smell and no nectar. The flowers are 5-8 mm long with 80-150 stamens and 2 ovules in each of the 2 locules. Petals and stamens are pinkish white. The style is slightly bent and the stigma is dry and raised c. 1-2 mm above the stamens. The locules are connected to the conducting tissue by compita which appear to open up at slightly different levels in the middle of each placenta (Fig. 2.7 B).

Fig. 2.6 - Daily flower production of two *Myrcia linearifolia* shrubs



Anthesis occurs between 6:30 and 7:00 a. m. (c. 1 hour after daybreak). The presumptive pollinators are *Bombus atratus* and *Bombus morio* (see Table 2.22). These bees will visit several of the many open flowers on a inflorescence, buzzing and contacting the stigma in the same manner as described for *Ptiloglossa* in *Siphoneugena*. *Trigona* sp was also observed to visit this species with stigmatic contact but instead of vibrating these bees walk over the stamens collecting pollen. Small pollen-eating beetles also visit the flowers but were not observed to contact the stigma.

Fruit-set results are presented in Table 2.6. Fruit-set of automatic self-pollinations was significantly higher ($t_{0.95} = 1.85$; $v = 102$) than that of self-pollinations. Fruit-set of cross-pollinations was significantly higher ($t_{0.95} = 3.53$; $v = 120$) than that of self-pollinations. In the experimental pollinations, young fruit abortion is concentrated in the first three weeks after anthesis, drops off sharply for another two weeks, increases in the 6th week and drops off

Fig. 2.7 - Illustrative fluorescence microscopy photographs of level of opening of the compita: A) *Siphoneugena densiflora* - compita opening at the same level in both locules B) *Myrcia linearifolia* - compita opening at different levels in the two locules C) *Blepharocalyx salicifolius* - compita opening at different levels in the two locules.

Fig. 2.7 - Illustrative fluorescence microscopy photographs of level of opening of the compita

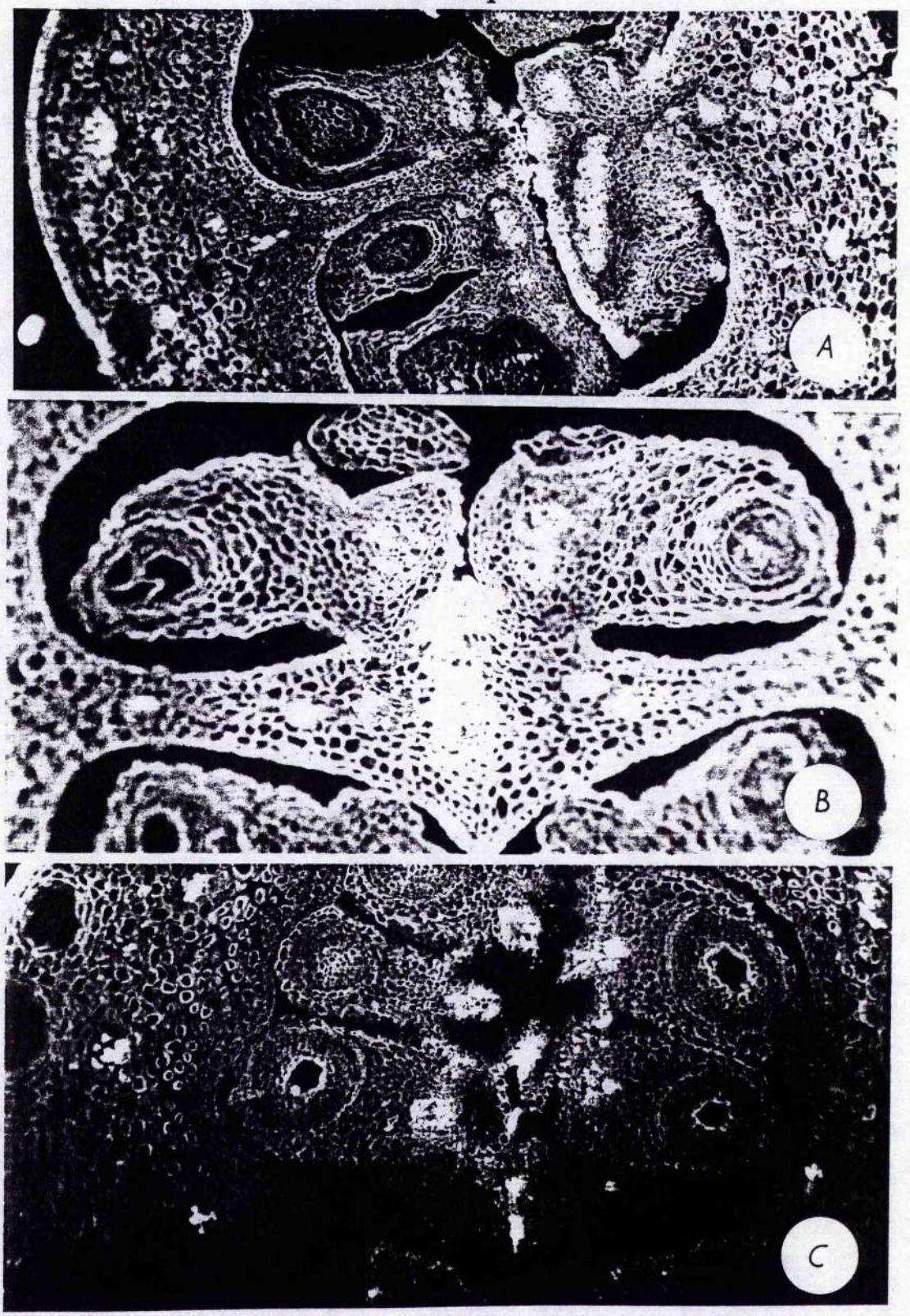


Table 2.6 - Fruit-set results from experimental pollination of *Myrcia linearifolia*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic	2	17	2	**11.76 %**
Self pollinations	4	87	2	**2.30 %**
Cross pollinations	2	35	7	**20.00 %**
Natural	1	125	17	**13.60 %**

again as the fruit start to swell. The PERS is probably between 2.27% and 6.80% and the IAS was 4.91.

Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.7.

Table 2.7 - Fluorescence microscopy data on fixed subsamples of *Myrcia linearifolia*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	**0 / 0**		
	0 / 0	**?**	**?**
	0 / 0		
	1 / 0		
Self-pollination	**3 / 0**	**3 / 0**	**4 / 1**
	3 / 0	**10 / 0**	**20 / 2**
	7 / 0		
	9 / 0		
	17 / 0		
	3 / 1		
Cross-pollination	**0 / 0**	**0 / 0**	**0 / 0**
	2 / 0	**0 / 0**	**3 / 0**
	5 / 0	**0 / 0**	**4 / 0**
	7 / 0	**1 / 0**	**12 / 0**
	6 / 1	**2 / 0**	**3 / 2**
		2 / 0	

For ovaries at 24 hours no ovule penetrations were observed in the automatic self-pollinations; the mean number of ovule penetrations observed in the self-pollinations (mean=0.17) did not differ significantly ($t_{0.95} = 1.06$; $v = 9$) from that of the automatic self-pollinations (mean=0); the mean number of ovule penetrations in the self-pollinations (mean=0.17) did not differ significantly ($t_{0.95} = 0.28$; $v = 10$) from that of the cross-pollinations (mean=0.2).

For ovaries at 48 hours automatic self-pollination material was uncollected; no ovule penetrations were observed in the other treatments.

For ovaries at 72 hours automatic self-pollination material was also uncollected; the mean number of ovule penetrations in the self-pollinations (mean=1.5) did not differ significantly ($t_{0.95} = 1.31$; $v = 5$) from that of the cross-pollinations (mean=0.4).

Discussion

Myrcia linearifolia appears to be a partially self-compatible species. In this series of experiments, automatic self-pollinations resulted in a significantly higher fruit-set than hand self-pollinations.

Myrcia fallax, a tree of venezuelan montane forests, had a similar fruit-set pattern (Sobrevila & Arroyo 1982). Both species had the highest fruit-set when hand-crossed (20 % for *M. linearifolia* and 37.14 % for *M. fallax*) but the lowest when hand-selfed (2.30 % and 10.25 % respectively), with automatic selfing producing an intermediate value (11.76 % and 27.78 % respectively). The IAS for *M. fallax* was 2.71 as compared to 4.91 for the present species. The authors noted that this indicated a 'very efficient automatic selfing mechanism' in *M. fallax.* In nature, however, this would mean that outcrossed flowers would be preferentially retained over automatically selfed flowers and that pollinator-mediated selfed flowers would suffer the highest abortion rates of all. It is easy to see the advantage of getting rid of an excess of selfed flowers when outcrossing has been good, yet retaining enough of them to make the reproductive effort worthwhile if it has not. But how can a distinction between automatically-selfed and pollinator-selfed flowers be made?

One answer that fits in with current knowledge could be through temporal breakdown of a self-incompatibility mechanism. The *Bombus* pollinators were

seen visiting the plants 1-2 hours after anthesis and most of my hand pollinations were done at a similar time. Pollen grains probably germinate promptly and pollen tubes grow quickly, as ovule penetrations were observed in material fixed at 24 hours. It is thus possible that at the time the pollen tubes normally penetrate the ovules they encounter a self-incompatibility reaction which will block those ovules to future fertilizations. But if the flower is not visited, its own pollen may not reach the stigma until much later in the day when stamens start to wilt and these laggard self-pollen tubes may not encounter this reaction by the time they reach the ovules. If this hypothesis is correct no fruits should have formed after hand self-pollinations but actually 2.3% were formed. Fluctuations in the time of breakdown, time of the pollinations and pollen tube growth could explain this very low fruit-set.

This hypothesis should be considered merely speculative, since it depends upon three unknown parameters: 1) that a self-incompatibility mechanism exists 2) that this mechanism lasts a relatively short period of time and 3) that pollen from the same flower regularly reaches the stigma later in the day if there is no pollinator activity. Unknown factors could actually be skewing the data. Future experiments in which the timing of self-pollinations were controlled could easily prove or disprove it.

The results for *M. linaearifolia* showed good pollen tube growth down to the ovary in hand self-pollinations so the abortion mechanism must operate at some stage after ovule penetration. The number of ovule penetrations in cross- and self-pollinations were also statistically equivalent.

If the temporal breakdown of self-incompatibility theory is applicable, I would not expect the automatic self-pollination mechanism of *M. linearifolia* to be particularly efficient, but quite the opposite. Self-incompatibility that later breaks down would only be effective in promoting outcrossing if automatic self-pollination, which translates as lack of visitation, were a relatively rare event and pollinator-mediated self-pollination quite a common one.

2.2.4 *Myrcia rhodosepala* Kiaersk.

This is a relatively common, 0.5 - 1.5 m high, hemixyle shrub found in campo limpo as well as in typical cerrado. The inflorescence is a terminal panicle but

large shrubs also produce many supra-axillary panicles at the highest nodes. One shrub can produce from several hundred to over a thousand flowers. Flowers have a sweet smell and no nectar. The flowers are 5-8 mm long with 50-150 stamens and 2 ovules in each of the 2 locules. Petals and stamens are white. The style is straight and the stigma is dry and raised c. 1-2 mm above the stamens.

M. rhodosepala flowers in late dry season to early wet season (August, September) and flowering lasts ca. 8 weeks. Flowering is highly synchronized in the population and occurs only on specific days with intervals between them. During daily field work in 1988 I observed 5 'flowering days' within a month: August 30th, September 6th, September 17th, September 21st and October 1st. The flowering episode of a particular plant usually spans 2 or rarely 3 such days.

Anthesis occurs between 6:00 and 6:30 a. m., which is about 30 minutes after daybreak. The inflorescence is very showy and flowers open slightly earlier than those of neighbouring species of Myrtaceae which were also in flower (*M. linearifolia* and *Psidium firmum).* The presumptive pollinator is *Bombus morio* (see Table 2.22). *M. rhodosepala* is apparently highly attractive to these bees, and I once observed 4 *Bombus* bees foraging simultaneously in a large shrub shortly after anthesis. This plant is also visited by *Xylocopa ciliata* and by *Trigona* (spp?). One such *Trigona* bee was observed to contact the stigma in roughly 20 % of flowers visited, whilst *Bombus morio* and *Xylocopa ciliata* contacted the stigma in virtually every flower visited. In early-morning visits (up to about 1 hour after anthesis). *Bombus morio* and *Xylocopa ciliata* spent 1-2 minutes on an inflorescence and effected buzz-pollination. Later *Bombus* visitors spent much less time per inflorescence, and sometimes vibrated, sometimes walked over the stamens or just hovered over the flowers a few seconds before flying away. Wasps and beetles also visited this species but rarely contacted the stigma.

Fig. 2.8 - Daily flower production of two shrubs of Myrcia rhodosepala

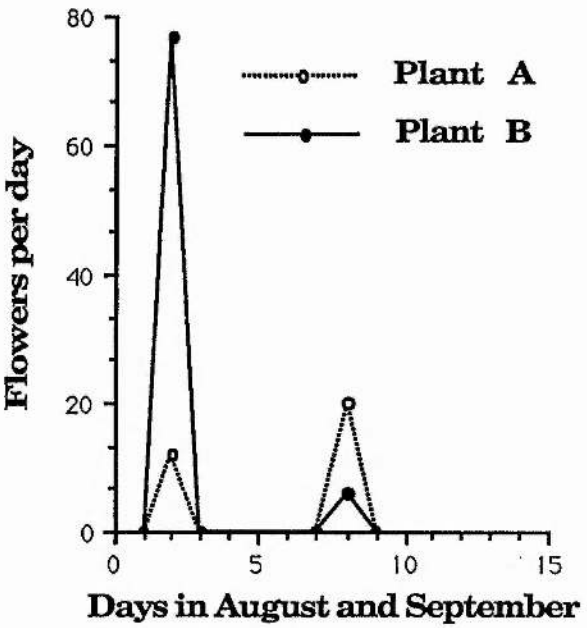


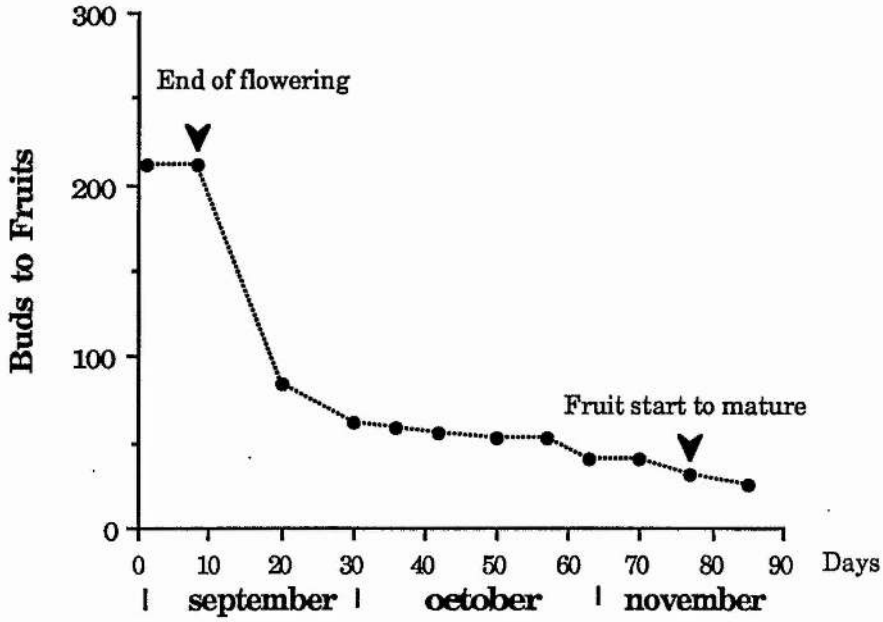
Table 2.8 - Fruit-set results from experimental and natural pollination of *Myrcia rhodosepala*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self pollinated	1	25	11	**44.00 %**
Self pollinated	2	21	13	**61.90 %**
Cross pollinated	2	12	6	**50.00 %**
Natural	5	212	31	**14.62 %**

Fruit-set results are presented in Table 2.8 and the fruit-set success curve in Fig 2.6. Fruit-set of hand self-pollinations was not significantly different from that of control self-pollinations ($t_{0.95} = 1.18$; $v = 44$) or of hand cross-pollinations ($t_{0.95} = 0.65$; $v = 35$). Massive flower abortion occurred in the first 12 days after flowering, decreased markedly until fruits began to swell, and then continued at a modest level. The PERS is expected to be between 2.49 % and 7.31 % and the

IAS is 0.71.

Fig. 2.9 - Fruit-set success curve for *Myrcia rhodosepala*



Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.9.

Ovaries at 24 hours had no ovule penetrations regardless of treatment.

Ovaries at 48 hours had no ovule penetrations for the automatic self-pollinations; the mean number of ovule penetrations observed in the hand self-pollination (mean=0.9) did not differ significantly ($t_{0.95} = 0.17$; $v = 7$) from that of the hand cross-pollination treatment (mean=1); the mean number of ovule penetrations in the control self-pollination (mean=0) did not differ significantly ($t_{0.95} = 1.55$; $v = 7$) from that of the self-pollinations (mean=0.9).

For ovaries at 72 hours control self-pollination material was uncollected; the mean number of ovule penetrations observed in the hand self-pollinations (mean=1.12) did not differ significantly ($t_{0.95} = 1.37$; $v = 9$) from that of the hand

cross-pollination treatment (mean=0.33). Several abnormal ovule penetrations were observed in ovaries 48 and 72 hours after self-pollination (Fig. 2.17 F).

Table 2.9 - Fluorescence microscopy data on fixed subsamples of *Myrcia rhodosepala*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	0/**0**	0/0	
	0/**0**	1/**0**	?
	0/**0**	2/**0**	
	3/**0**		
Self-pollination	1/**0**	0/**0**	4/**0**
	1/**0**	5/**0**	1/**1**
	2/**0**	4/**1**	2/**1**
	3/**0**	4/**1**	2/**1**
	6/**0**	7/**1****	3/**1**
	8/**0**	9/**2**	5/**1****
	9/**0**		7/**1**
			10/**1**
			10/**1****
			6/**3**
Cross-pollination	1/**0**	1/**0**	2/**0**
	6/**0**	7/**0***	4/**0**
	7/**0**	6/**1**	6/**1**
	7/**0**	12/**1**	
	8/**0**	3/**2**	

* ovarian tissue covering ovules - not used in means
** penetration abnormal - not used in means

Discussion

Myrcia rhodosepala is a completely self-compatible species in which automatic self-pollination, self- and cross-pollinations are equally efficient in setting fruit. Nor does there not seem to be any difference in pollen tube growth or ovule penetration up to 72 hours.

M. rhodosepala is not a very diverse species morphologically but the low PERS range does not suggest habitual inbreeding. I suspect a limited amount of outcrossing is probably attained by the perfectly synchronized flowering strategy allied to early anthesis.

The fruit-set success curve shows a very high level of flower abortion (c. 70%) in the first 12 days after flowering. Since this species depends exclusively on visitation patterns for outcrossing, excess flowers may be produced for pollinator attraction.

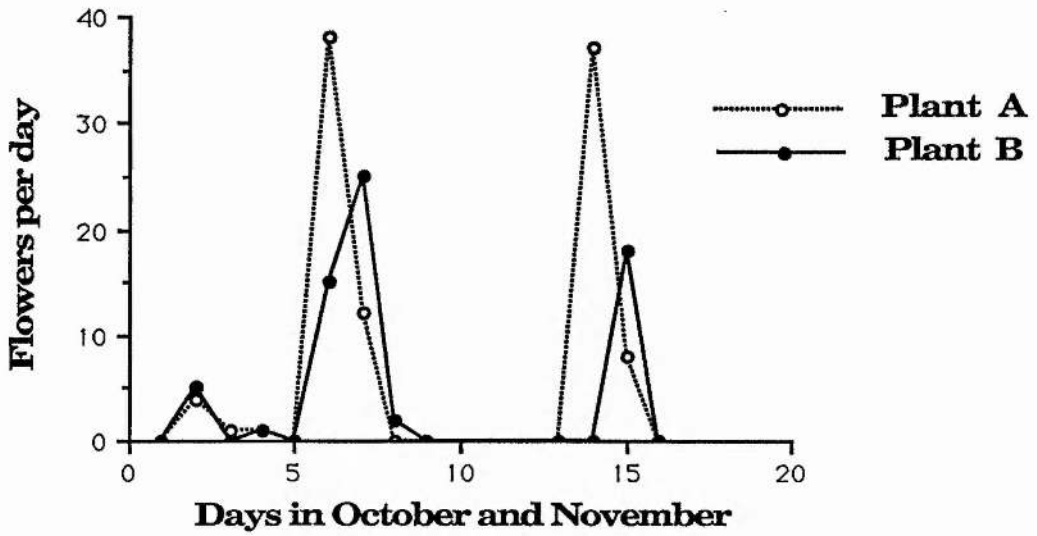
2.2.5 *Blepharocalyx salicifolius* (HBK.) Berg

This is a very widespread species with great variation. The form studied is a 5-12 m tree and is quite common in cerrado *sensu stricto* and in cerradão.

The inflorescence is usually a 3-15 flowered dichasium with sessile flowers in the forks, but solitary flowers or 31-flowered dichasiums are sometimes encountered. The flowers have no nectar and a sweet smell. Flowers are c. 8 mm with 130-180 stamens and 3-6 ovules in each of the two locules. The petals and stamens are white. The style is slightly bent and the stigma is dry and raised c. 1-2 mm above the stamens. The style is connected to the locules by compita which open up at different levels in the middle of each placenta through which the pollen tubes pass (Fig. 2.7 C).

B. salicifolius flowers in early wet season (September, October). Flowering lasts c. 8 weeks and an individual tree is usually in flower for about 3 weeks. Flowers do not open every day. Seventy-three point one percent (73.1 %) of the buds produced flowers. The sessile flowers always open sequentially starting with the eldest and only after all the sessile flowers on an inflorescence have opened do the lateral flowers start to open. The daily flower production of this species is illustrated in Fig 2.10.

Fig. 2.10 - Daily flower production of two *Blepharocalyx salicifolius* trees



I did not observe anthesis in this species. By 7:00 a. m. flowers are open and the trees observed were being visited by a large variety of insects. The following visitors were registered: *Ceratilictus theius (*), Centris violaceus, Xylocopa frontalis, Bombus atratus (*), Trigona spinipes (*), Trigona branneri (*), Scaptotrigona postica (*) Partamona cupira (*), Melipona quinquefasciata (*),* all bees, and several kinds of wasps. All seemed to contact the stigma except the wasps. *Bombus atratus (*), Melipona quinquefasciata (*)* and *Centris violaceus* were observed to effect buzz-pollination.

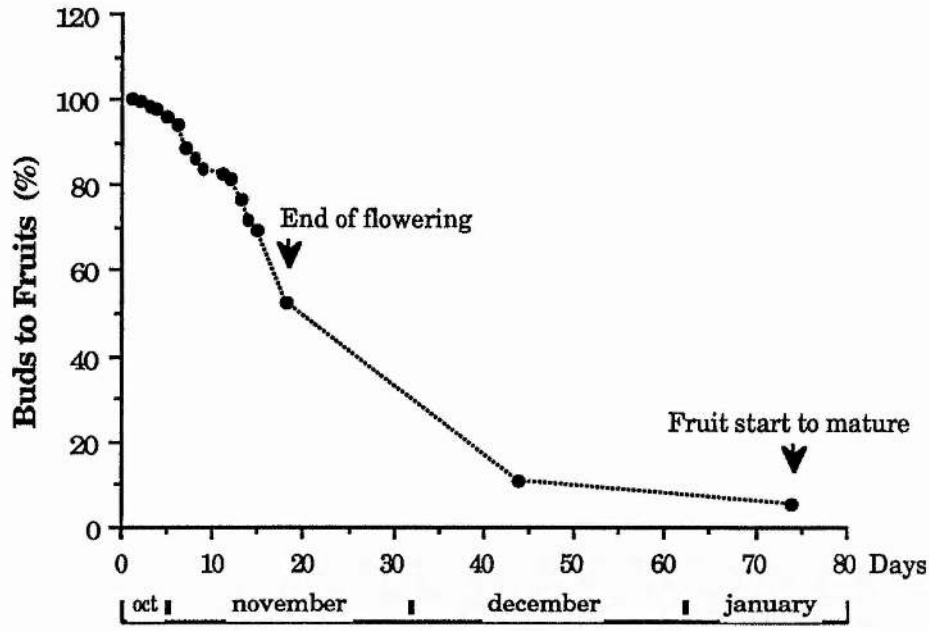
Table 2.10 - Fruit-set results from experimental and natural pollination of *Blepharocalyx salicifolius*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self pollination	3	32	0	**0 %**
Self-pollination	3	42	0	**0 %**
Cross-pollination	1	6	2	**33.33 %**
Natural	2	126	9	**7.14 %**

Fruit-set results are presented in Table 2.10 and the fruit-set success curve in Fig. 2.11. Neither control nor hand self-pollinations set fruit. Fruit-set in the

cross-pollinations was significantly higher ($t_{0.95} = 4.45$; $v = 46$) than in the self-pollinations (0). The PERS is expected to be between 0.75 % and 7.14 % and the IAS is null.

Fig. 2.11 - Fruit-set success curve for *Blepharocalyx salicifolius*



Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.11.

Ovaries at 24 hours had no ovule penetrations for the automatic self-pollinations nor for the cross-pollinations; the mean number of ovule penetrations observed in the self-pollinations (mean=0.2) did not difffer significantly ($t_{0.95} = 0.79$; $v = 7$) from that of the hand cross-pollination treatment (0); the mean number of ovule penetrations in the control self-pollination (0) did not differ significantly ($t_{0.95} = 0.53$; $v = 5$) from that of the self-pollinations (mean=0.2).

At 48 hours, the mean number of ovule penetrations observed in the self-pollinations (mean=5) did not differ significantly ($t_{0.95} = 0.40$; $v = 6$) from that of the hand cross-pollination treatments (mean=6); the mean number of ovule penetrations observed in the control self-pollination (mean=0.5) did not

differ significantly ($t_{0.95} = 1.57$; $v = 5$) from that of the self-pollinations (mean=5).

At 72 hours, the mean number of ovule penetrations observed in the self-pollinations (mean=1.4) did not differ significantly ($t_{0.95} = 0.76$; $v = 6$) from that of the cross-pollinations (mean=4); the mean number of ovule penetrations in the automatic self-pollinations (mean=2) did not differ significantly ($t_{0.95} = 0.27$; $v = 5$) from that of the self-pollinations (mean=1.4).

Table 2.11 - Fluorescence microscopy data on fixed subsamples of *Blepharocalyx salicifolius*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	0 / **0**	0 / **0**	0 / **0**
	3 / **0**	2 / **1**	±12 / **4**
Self-pollination	3 / **0**	2 / **0**	±10 / **0**
	±20 / **0**	7 / **4**	±15 / **0**
	±20 / **0**	±15 / **5**	±20 / **0**
	±30 / **0**	±30 / **7**	±15 / **3**
	±10 / **1**	±30 / **9**	±15 / **4**
Cross-pollination	4 / **0**	±20 / **4**	9 / **3**
	6 / **0**	±20 / **6**	±10 / **4**
	6 / **0**	±35 / **8**	±20 / **5**
	±12 / **0**		

Discussion

Blepharocalyx salicifolius appears to attract a large group of pollinators similar to *Eugenia dysenterica,* but since I did not observe anthesis, it could have a specialized early-morning pollinator like *Siphoneugena densiflora.* This does not seem likely, however, since *Siphoneugena* was rarely visited later in the morning except by the opportunistic *Apis mellifera,* while *Blepharocalyx salicifolius* and *Eugenia dysenterica* were intensely visited the whole morning. It is also markedly self-incompatible, but, as in *Siphoneugena densiflora,* the

self-incompatibility reaction appears to take place after ovule penetration.

2.2.6 *Campomanesia pubescens* (DC.) Berg

This is a relatively common shrub in most kinds of Distrito Federal cerrado. As with *Eugenia dysenterica* the inflorescence is a so-called precocious raceme that appears slightly before the new leaf crop thus making the flowers more conspicuous. A shrub usually produces from about 50-500 flowers. Flowers have a sweet smell and no nectar and are c. 1.5 cm long. The petals and stamens are white. There are c. 90-130 stamens and 5-12 ovules in each of the 4-8 locules. The style is straight and the capitate stigma is usually raised 1-3 mm above the stamens. The locules are arranged in a pentagon and connected to the style by one compita per loculus which open up at the same level in the middle of each placenta.

Campomanesia pubescens flowers in late dry season to early wet season (August, September, October) and flowering lasts ca. 12 weeks. Since bud growth is very rapid, 100% of the buds produced flowers, albeit some of them were slightly damaged at anthesis. There is a tendency for proximal inflorescences to flower before distal ones. Daily flower production of two shrubs in campo sujo is illustrated in Fig 2.12.

I did not observe anthesis in this species. By 7:00 a. m. flowers were open and being visited. The presumptive pollinators are two different species (sexes? casts?) of *Bombus* but I also observed this species being visited by *Trigona* sp., and briefly investigated by *Xylocopa frontalis*. It also attracts various wasps and beetles but these rarely alight or when they do so fail to contact the stigma.

Fruit-set results are presented in Table 6.1 and the fruit-set success curve in Fig 2.10. Cross-pollinations were not left to set fruit. Fruit-set in the self-pollinations did not differ significantly ($t_{0.95} = 0.2$; $v = 32$) from that of the automatic self-pollinations. The PERS was 4.73 % and the IAS was 0.83.

Fig. 2.12 - Daily flower production of three shrubs of *Campomanesia pubescens*

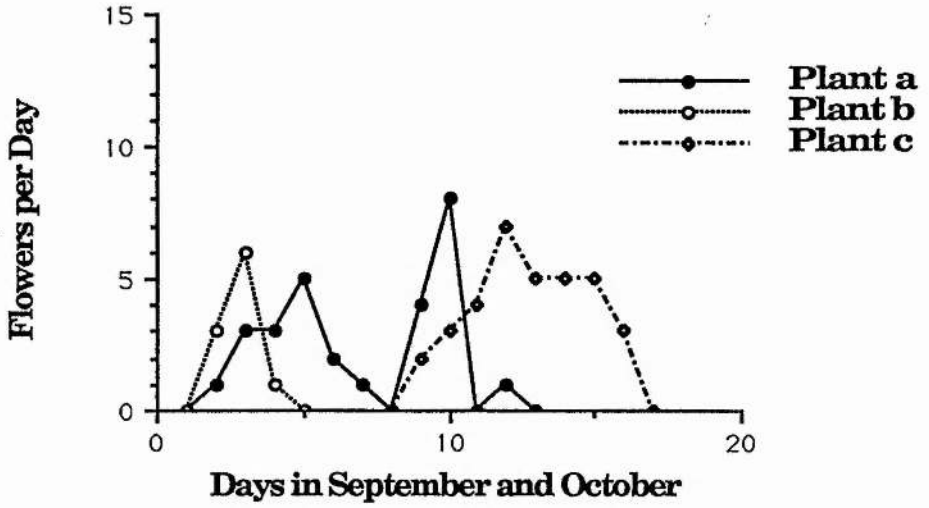


Table 2.12 - Fruit-set results from experimental and natural pollination of *Campomanesia pubescens*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self-pollination	2	19	1	**5.26 %**
Self-pollination	1	15	1	**6.67 %**
Natural	10	152	67	**18.52 %**

Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.13.

Fig. 2.13 - Fruit-set success curve for *Campomanesia pubescens*

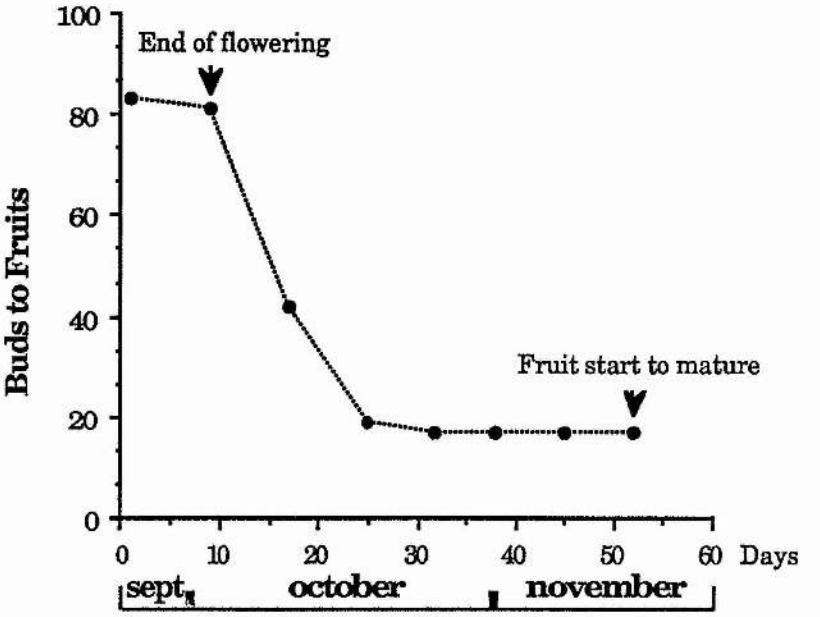


Table 2.13 - Fluorescence microscopy data on fixed subsamples of *Campomanesia pubescens*

Treatment	Pollen tubes / **Penetrated ovules** (per flower)		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	**2 / 0** **±10 / 0**	**0 / 0** **±10 / 0**	**0 / 0** **±20 / 1** **±10 / 2**
Self-pollination	**0 / 0** **3 / 0** **? / 6**	**0 / 0** **3 / 0** **? / 3**	**±7 / 2** **? / 3** **? / 3-6***

*** 3** used to calculate mean

For ovaries at 24 hours no ovule penetrations were observed in the automatic self-pollinations; the mean number of ovule penetrations observed in the self-pollinations (mean=2) did not differ significantly ($t_{0.95} = 0.63$; $v = 3$) from that of the automatic self-pollinations (0) .

For ovaries at 48 hours the mean number of ovule penetrations observed in

the automatic self-pollinations (mean=0.5) did not differ significantly ($t_{0.95}$ = 1.67; v = 3) from that of the self-pollinations (mean=1).

For ovaries at 72 hours the mean number of ovule penetrations observed in the automatic self-pollinations (mean=1) did not differ significantly ($t_{0.95}$ = 2.04; v = 4) from that of the self-pollinations (mean=2.67).

Discussion

This species is very likely self-compatible but the low PERS would seem to indicate a certain level of outbreeding. Flowering strategy is of the big-bang (sensu Gentry 1974) type and this may promote some outbreeding.

2.2.7 *Campomanesia velutina* (Camb.) Berg

In the Distrito Federal this is a rare tree that occurs in the fringes of dry gallery forests. The flowers are similar to those of *Campomanesia pubescens* , only slightly smaller and with sepals that reflex after flowering; the ovary has 4-5 locules with 2-9 ovules per locule and there are c. 70-110 stamens. Also, the compita connecting the style to the locules open up at different levels along the central shaft and this is a reflection of the locules which are arranged in a spiral instead of a pentagon.

C. velutina flowers in late dry to early wet season (September, October) and flowering lasts a few weeks. An individual tree can produce from about 800 to 5,000 flowers. The inflorescence is a precocious raceme like in *C. pubescens.* In the trees observed intense flower production lasted for about 5 days although some flowers could be found about a week before to a week after. Daily flower production of a small tree is illustrated in Fig 2.14.

Anthesis occurs between 6:00 and 6:30 a. m. (c. 30 minutes after daybreak). The probable pollinator was *Bombus morio (*)* and perhaps *Bombus atratus* (see Table 2.22). This plant also attracts *Trigona* sp. and cursory visists from *Xylocopa frontalis* but only the *Bombus* bees contacted the stigma.

Fig. 2.14 - Daily flower production of a tree of *Campomanesia velutina*

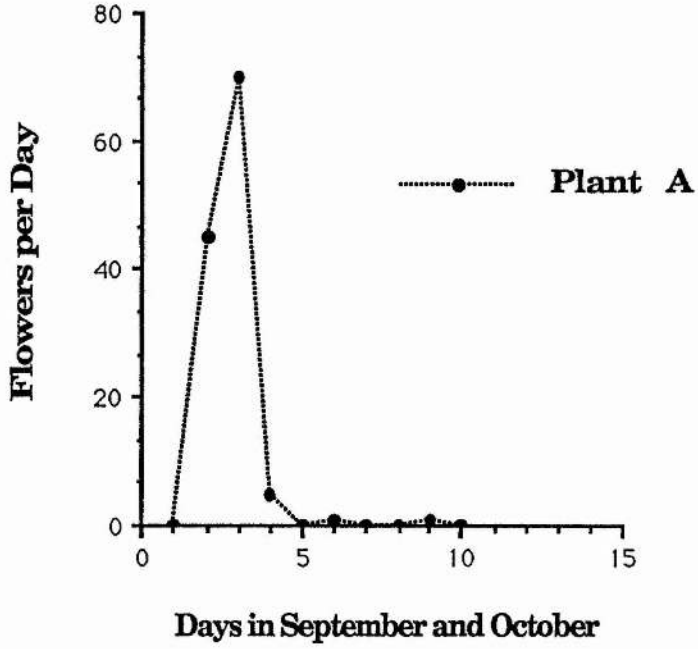


Table 2.14 - Fruit-set results from experimental and natural pollination of *Campomanesia velutina*

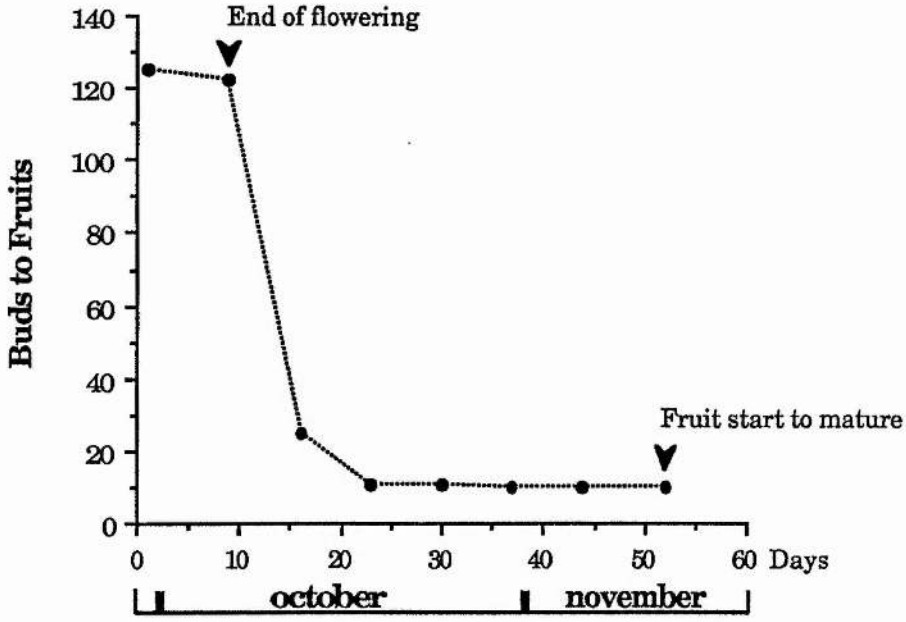
Treatment Set	Plants	Flowers	Fruits	Fruit
Automatic self pollination	2	9	0	**0 %**
Self-pollination	3	33	1	**0 %**
Cross-pollination	2	26	7	**26.92 %**
Natural	1	122	10	**8.20 %**

Fruit-set results are presented in Table 2.14 and the fruit-set success curve in Fig 2.15. The PERS is expected to be between 0.27% and 4.10% and and the IAS was null. It should be noted that the cross-pollinations using two trees only c. 10 m from each other (siblings ?) yielded 0 % (n=19) fruit set, while when another

distant tree was used as female plant, cross pollinations yielded 100 % (n=7) fruit set, so the mean cross-pollination fruit set of 26.92 % may be a considerable underestimate of the true value. The only fruit produced by self-pollination in this distant tree was half the size of those resulting from cross-pollinations on another branch of the same tree.

Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.15.

Fig. 2.15 - Fruit-set success curve for *Campomanesia velutina*



Ovaries at 24 hours had no ovule penetrations for the automatic self-pollinations or for the cross-pollinations; the mean number of ovule penetrations in the self-pollinations (mean=0.25) did not differ significantly ($t_{0.95} = 0.43$; $v = 6$) from that of the cross-pollinations (0); the mean number of ovule penetrations in the automatic self-pollinations (0) did not differ significantly ($t_{0.95} = 0.43$; $v = 6$) from that of the self-pollinations (mean=0.25).

Table 2.15 - Fluorescence microscopy data on fixed subsamples of *Campomanesia velutina*

Treatment	Pollen tubes in style / **Penetrated ovules**		
Time elapsed	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	0 / 0 0 / 0	?	0 / 0 4 / 0
Self-pollination	0 / 0 1 / 0 2 / 0 4 / 0 ±20 / 0 8 / 2	±15 / 0 ±50 / 3 ±30 / 4	4 / 0 ±30 / 1 ±40 / 2
Cross-pollination	0 / 0 1 / 0	0 / 0 0 / 0 2 / 0 ±10 / 0 ±10 / 2	0 / 0 0 / 0 1 / 0 2 / 0 ±10 / 2

For ovaries at 48 hours, automatic self-pollination material was uncollected; the mean number of ovule penetrations observed in the self-pollinations (mean=2.33) did not differ significantly ($t_{0.95} = 0.15$; $v = 6$) from that of the cross-pollinations (mean=0.4).

For ovaries at 72 hours, the mean number of ovule penetrations observed in the self-pollinations (mean=1) did not differ significantly ($t_{0.95} = 0.70$; $v = 6$) from that of the cross-pollinations (mean=0.4); the mean number of ovule penetrations in the automatic self-pollinations (0) did not differ significantly ($t_{0.95} = 0.36$; $v = 3$) from that of the self-pollinations (mean=1).

Discussion

C. velutina, like *Siphoneugena densiflora,* appears to have late-acting self-incompatibility, with pollen tubes penetrating ovules being observed following selfing (Fig. 2.17 A & B) but no fruit forming. It was observed that in the natural pollinations fruit set was greater in inflorescences that opened flowers towards the end of the flowering period. This concurs with the theory

put forward by Stephenson (1982) that outcrossing in mass-flowering plants occurs predominantly in the decrease phase of the flowering episode.

2.2.8 *Psidium firmum* Berg

This is a common shrub in most kinds of cerrado. Flowers have a sweet smell and no nectar and are c. 2 cm long. The petals and stamens are cream white. There are 150-300 stamens and about 20-50 ovules in the 4-5 locules. The style is straight and the capitate stigma is usually raised 1-3 mm above the stamens, but flowers in which stigma and anthers are on the same level can be found. The style center is composed of lacunose tissue from about the middle downwards. The locules form a pentagon and are connected to the style by one compita per loculus which open up at the same level in the middle of each placenta.

P. firmum flowers in late dry season (July to September) and flowering lasts ca. 12 weeks. A shrub usually produces from a few to about 50 flowers. The inflorescence is an axillary dichasium with 1-15 flowers. There is a tendency for proximal inflorescences to flower before distal ones. Daily flower production of two shrubs in a campo limpo is illustrated in Fig 13.

Anthesis occurred between 6:00 and 6:30 a. m., about one hour after daybreak, and is of the *Eugenia dysenterica* type. The presumptive pollinator is *Bombus morio* (see Table 2.22). *Ceratina gossypii* was also seen visiting this species and making stigmatic contact. Shrubs that produced many flowers were also visited by *Trigona* sp. and by introduced *Apis mellifera*. Flowers were also visited by minute pollen-eating beetles which were not observed to contact the stigma.

Fruit-set results are presented in Table 2.16 and the fruit-set success curve in Fig 2.18. Fruit-set in the self-pollinations was significantly higher ($t_{0.95} = 2.56$; v = 34) than in the automatic self-pollinations. Fruit-set of the cross-pollinations did not differ significantly ($t_{0.95} = 1.16$; v = 37) from that of the self-pollinations. Young fruit abortion was evenly spaced over fruit maturation and was often caused by insect predation. Predated young fruits became prematurely soft and were abscised. When opened, the flesh inside these fruits had brownish areas

and one or more developing larvae were found. The IAS was 0.46 and the PERS range between 4.56 % and 12.75 %.

Fig. 2.16 - Daily flower production of two *Psidium firmum* shrubs

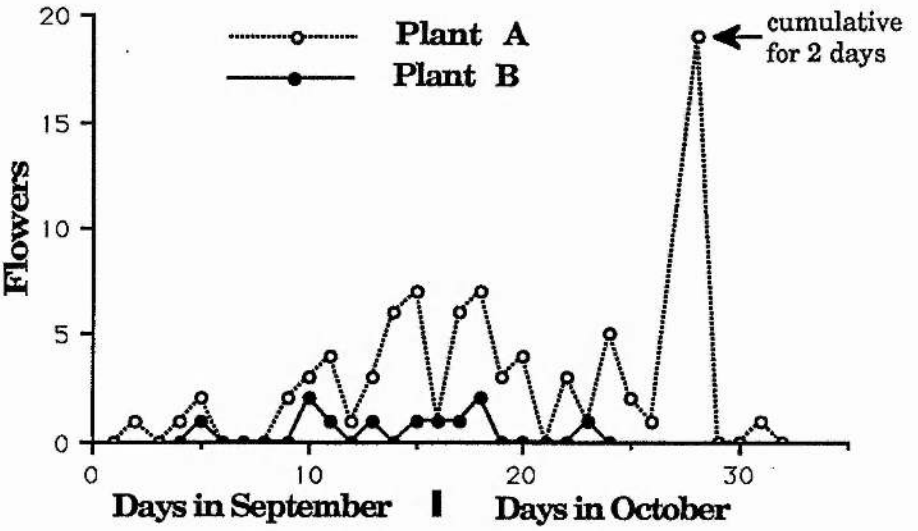


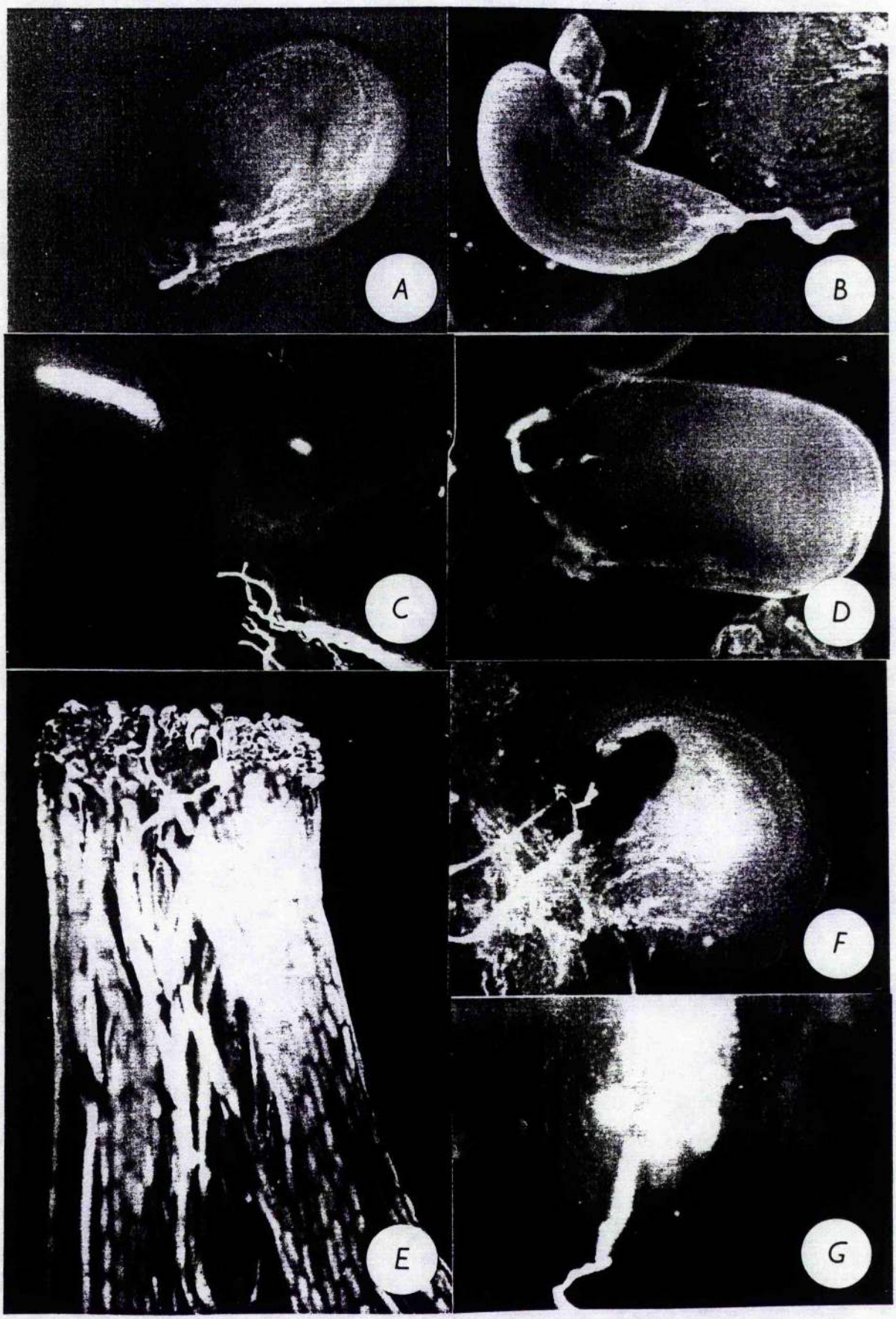
Table 2.16 - Fruit-Set Results from Experimental and Natural Pollination of *Psidium firmum*

Treatment	Plants	Flowers	Fruits	Fruit Set
Automatic self pollination	3	8	3	**37.50 %**
Self-pollination	4	28	23	**82.14 %**
Cross-pollination	3	11	7	**63.63 %**
Natural	10	152	67	**44.08 %**

At a later stage, some fruit loss was also caused by mammal predation. In one case, the animal gnawed through the stem to get the unripe fruit on the ground where it was abandoned after a few superficial bites. A few days later a mature fruit was thoroughly opened and the soft, placental flesh that surrounds the seeds eaten. Many (but not all?) seeds, as well as the leathery skin, were left. Faeces were deposited near and on the remains of the fruit and these were identified as probably pertaining to a small semi-arboreal rodent such as *Rhipidomys* or *Oryzomys* sp. (Alho, personal communication).

Fig. 2.17 - Illustrative fluorescence microscopy photographs of pollen tubes: A) *Campomanesia velutina* - self pollen tubes penetrating the ovule at 24 hs B) *Campomanesia velutina* - self pollen tubes penetrating the embryo sac of the ovule seen in A C) *Psidium firmum* - self-pollen tubes close to micropyle at 72 hs D) *Psidium firmum* - cross-pollen tubes penetrating ovules at 48 hs E) pollen tubes of*Myrcia rhodosepala* growing down the style of *Myrcia linearifolia* at 24 hs F) *Myrcia rhodosepala* - abnormal ovule penetrations 48 hs after selfing G) *Siphoneugena densiflora* - self-pollen tubes penetrating ovules at 72 hs.

Fig. 2.17 - Illustrative fluorescence microscopy photographs of pollen tubes



Data for fixed subsamples of treatments examined under the fluorescence microscope for pollen tube growth and ovule penetration are presented in Table 2.17.

Fig. 2.18 - Fruit-set success curve for Psidium firmum

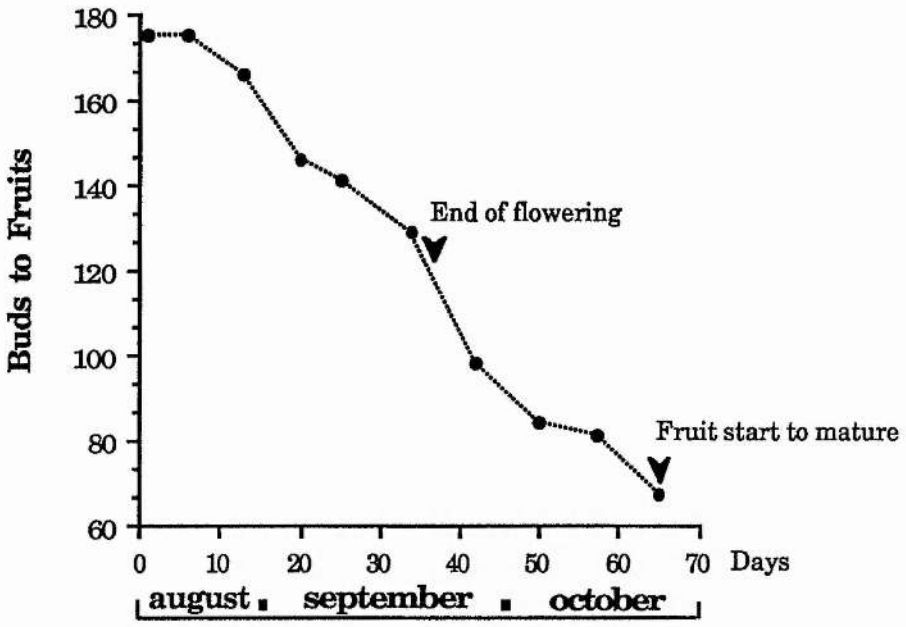


Table 2.17 - Fluorescence microscopy data on fixed subsamples of *Psidium firmum*

Treatment	Pollen tubes / **Penetrated ovules**		
Time expired	**24 hs**	**48 hs**	**72 hs**
Automatic self-pollination	0 / **0** ±30 / **0**	5 / **0**	2 / **0** 7 / **0**
Hand self-pollination	0 / **0** 3 / **0**	0 / **0** 3 / **0**	±90 / **0** ±120 / **0**
Hand cross-pollination	±40 / **0**	±50 / **2** ±100 / **2**	±60 / **2** ±100 / **6**

At 24 hours ovaries had no ovule penetrations regardless of treatment.

At 48 hours the automatic self-pollinations and the hand self-pollinations had no ovule penetrations. The mean number of ovule penetrations observed in the cross-pollinations (mean=2) was significantly higher (s = 0; v = 2) than in the self-pollinations (0).

At 72 hours, the automatic self-pollinations and the hand self-pollinations had no ovule penetrations; however, the mean number of ovule penetrations observed in the cross-pollinations (mean=4) did not differ significantly ($t_{0.95}$ = 1.41; v = 2) from that of the self-pollinations (0).

Discussion

Psidium firmum is a totally self-compatible species. However, the species has an accentuated morphological diversity and a relatively low probable PERS which do not suggest dominant inbreeding. The low IAS (0.46) allied to significantly lower fruit set in automatic self-pollinations suggest that, in nature, pollinator visits (effecting either self- or cross-pollination) will increase fruit yield but are not essential for the plant to set fruit. It is interesting that this is the only species studied in which herkogamy is not fixed, i. e., the stigma varies between c. 3 mm to not at all elevated above the anthers. This last state (no herkogamy at all) is rather rare but occurs sporadically amongst the flowers of some of the individuals.

A certain degree of outcrossing is probably attained by the prolonged steady-state flowering strategy (sensu Gentry 1974) allied to a trap-liner pollinator (Janzen 1971). Another possibility is that some form of 'preferential self-exclusion' may be operating in this species, similar to that proposed by Bowman (1987) for *Clarkia unguiculata* (Onagraceae, Myrtales). *C. unguiculata* is a totally self-compatible species in which the use of a genetic marker (flower colour) revealed that 58-100 % of the progeny of mixed self- and cross-pollen was actually outcrossed. The author suggested that this was because faster-growing cross-pollen tubes were responsible for most fertilizations. In *P. firmum* we observed no self pollen tubes penetrating ovules up to 72 hours while cross pollen tubes were observed penetrating ovules at 48 and 72 hours. This certainly seems to suggest that cross pollen tubes are growing faster than self pollen tubes although the samples (both n=2) were

insufficient for statistical inference. In 72-hour ovaries, several self pollen tube tips were observed quite close to the ovules (Fig. 2.17 C) but either had not had enough time to penetrate the micropyles or else were somehow arrested at this point while cross-pollen tubes (Fig. 2.17 D) of the same age had already reached the ovules. Self-fertilizations presumably did occur at a later stage though, since fruit-set following selfing was as successful as after crossing.

2.2.9 Interspecific Hybridization

Three different intrageneric crosses were attempted within *Myrcia* and *Campomanesia* :

Table 2.18 - Results from Campomanesia pubescens (f) x C. velutina (m) crosses

	Pollen tubes / **Penetrated ovules**	
Time expired	**72 hs**	**Left to produce fruit**
	±70/ **2**	fruit matured
	±70 / **1**	fruit matured
	±50 / **3 or 4**	

Table 2.19 - Results from Myrcia linearifolia (f) x M. rhodosepala (m) crosses

	Pollen tubes / **Penetrated ovules**	
Time expired	**24 hs**	**Left to produce fruit**
	±25 / **0**	flower aborted
	±10 / **0**	flower aborted
	±10 / **0**	flower aborted
	5 / **0**	flower aborted
	0 / **0**	flower aborted

Table 2.20 - Results from Myrcia torta (f) x M. linearifolia (m) crosses

Pollen tubes / **Penetrated ovules**

Time expired	**24 hs**	**Not left to produce fruit**
	12/2	
	7/1	
	7/0	

Discussion

1) *Campomanesia pubescens* (female) x *Campomanesia velutina* (male) - These two species flower simultaneously but in the Distrito Federal are separated by habitat and height since *C. velutina* is a rather rare gallery forest fringe tree and *C. pubescens* is a common cerrado shrub. They are both visited by bees of the genus *Bombus* but presumably remain distinct due to the habitat specificity and tendency to forage at definite heights of these bees. Crosses produced mature fruit but since flowers were not emasculated and *C. pubescens* is a self-compatible species, the possibility that the pollen tubes growing down the style were actually self-pollen tubes must be considered. It should be mentioned, however, that the six automatic self-pollination treatments for *C. pubescens* showed 0 - ±20 pollen tubes.

C. velutina, the male parent, is self-incompatible while *C. pubescens,* the female parent, is probably self-compatible (see discussion of this species). This cross thus concurs with the rule of unilateral interspecific compatibility (Harrison & Darby 1955, Lewis & Crowe 1958) which states that crosses in which either the female parent is self-compatible or both parents are self-incompatible usually succeed, while the cross of a self-incompatible female with a self-compatible male usually fails.

2) *Myrcia linearifolia* (female) x *Myrcia rhodosepala* (male) - These are both relatively common cerrado shrubs which flower simultaneously. They are both probably pollinated by bees of the genus *Bombus.* Crosses did not set fruit, although pollen tubes of *M. rhodosepala* did grow down the styles of *M. linearifolia* (Fig. 2.17 E). This is not surprising since it would be hard to imagine what factor could be maintaining the species separate should they

prove interfertile.

The female parent is partially self-incompatible (see discussion of *M. linearifolia*) and the male parent self-compatible so the lack of fruit in this cross also agrees with the law of unilateral self-incompatibility. Presumably, there are additional barriers to hybridization or to the establishment of the hybrids, without which reciprocal crosses would have long since broken down the species.

3) *Myrcia torta* (female) x *Myrcia linearifolia* (male) - These two species are also common cerrado shrubs. Based on my subjective observations during 1987, there was a small overlap in flowering period, so that the last stragglers of *M. linearifolia* were in flower simultaneously with the *M. torta* early bloomers. *M. linearifolia* is probably pollinated by *Bombus morio.* The pollinator of *M. torta* is unknown. Pollen tubes of *M. linearifolia* grew down the style of *M. torta* and ovule penetratrions were observed. I did not leave flowers to set fruit in this cross.

2.3 Conclusions

Although based upon an obviously small sample, these results allied to previous studies suggest certain reproductive patterns within the Neotropical Myrtaceae which are analysed here. These should be seen in the light of guidelines to further research rather than as final statements.

2.3.1 Floral Biology

Bee-pollination appears to be the norm and the Myrtaceae-Colletidae association that is so striking in Australia probably persists at least to some extent in the Neotropics. Among the few species investigated, two cases have already been registered, one in this study and another by Frankie et al. (1983), both in subtribe Eugeniinae. Both species have very early anthesis of the flowers and are pollinated shortly before dawn by *Ptiloglossa* sp.

Two different modes of anthesis were found to occur. In *Eugenia dysenterica,*

Psidium firmum and *C. velutina* the style was bent at the tip or erect and the filaments were crumpled rather irregularly. After the petals had opened anthers in various stages of anthesis became visible as the style and filaments expanded and the flower assumed its normal appearence. In *Siphoneugena densiflora, Myrcia rhodosepala* and *M. linearifolia* the style and stamens were all neatly incurved so that no anthers were visible after the petals had opened. The style was bent almost in two and usually was the first to straighten itself and protrude above the bundle of filaments which then began to uncurled starting with the outermost whorls. Anthers did not open until a few minutes after the flower was completely expanded.

2.3.2 Breeding Systems

All the Myrtaceae investigated had hermaphrodite flowers. PERS values were far below the 22% maximum threshold found by Wiens (1984) for outbreeding species. This would indicate that the family is predominantly outbreeding, although both self-compatible and self-incompatible species were found.

It is considered likely that flowering strategies, some of which capitalize upon trap-lining and some on opportunistic behaviour by the pollinators are probably the strongest factors promoting outbreeding in self-compatible species. Another possible explanation for outbreeding in self-compatible species (which should be verified by *ad hoc* experimentation) is retarded growth of self pollen tubes as compared to cross pollen tubes, at least in *P. firmum* (see discussion of this species).

In the self-incompatible species the site of the incompatibility barrier was found to be located within the ovules. It is not known, in fact, if this is true pre-zygotic self-incompatibility as defined by de Nettancourt (1977) or rather abortion of selfed zygotes. In *Campomanesia velutina* and *Blepharocalyx salicifolius* abortion of selfed pistils occurred a few days after pollination while in *Siphoneugena densiflora* this event took a month to occur. In both species, however, abortion was synchronous and happened before ovary enlargement. This suggests late-acting self-incompatibility (Seavey & Bawa 1986) and not zygotic inbreeding depression in which abortion would be expected to be

staggered through the various stages of development.

Results obtained in experimental hybridization in *Darwinia* (Briggs 1964) also support the idea a pre-zygotic incompatibility mechanism exists in Myrtaceae. Briggs observed ovule penetrations both in *D. fascicularis* (f) x *D. biflora* (m) and in the reciprocal *D. biflora* (f) x *D. fascicularis* (m), but when the shorter-styled *D. biflora* was used as pollen plant there was no zygote formation up to 48 days and no fruit-set. Since the *D. biflora* pollen tubes were clearly capable of the extended growth necessary to traverse the longer *D. fascicularis* styles, the author suggested that this unnatural extended growth could be interfering in some way with the ability of the male gametes to effect fertilization of either the endosperm or the egg cell.

The *Darwinia* species studied by Briggs are all self-compatible but it is conceivable that the same mechanism which prevents zygote formation in *D. fascicularis* (f) x *D. biflora* (m) crosses could be acting in intraspecific self-incompatibility in other Myrtaceae. Unilateral compatibility between species has been found to be related to the intraspecific compatibility systems operating within the parent species, although most genera studied have gametophytic systems, e. g., *Solanum* (Lewis & Crowe 1958). Late-acting self-incompatibility might, however, operate on a completely different genetic control. Furthermore, within a species there would be no differences in style length between male and female parents so the reaction must be capable of acting independently of style length yet be somehow influenced by it.

It is of additional interest that in *Darwinia* (Myrtaceae) the fusion of the polar nuclei was found to occur 2 days after ovule penetration, while the fertilization of the egg did not take place until c. 14 days later (Prakash 1969). A similarly slow fertilization could explain the delay in the abortion of selfed ovaries in *Siphoneugena*. Whatever the exact mechanism, it will be called 'self-incompatibility' from here onwards.

2.3.3 Flowering Strategies

Three of the now classic flowering strategies registered for Bignoniaceae in Costa Rica by Gentry (1974) were found to occur in the Distrito Federal Myrtaceae:

A) A typical 'big-bang' flowering strategy occurs in two of the trees, self-compatible *Eugenia dysenterica* and self-incompatible *Campomanesia velutina,* and in the self-compatible shrub *Campomanesia pubescens.* Synchronous flowering lasted about a week with large quantities of flowers being produced along with the new leaf crop, thus making them very conspicuous.

A slight modification of the big-bang flowering strategy which I will call a 'pulsed-bang' flowering strategy was found to occur in *Blepharocalyx salicifolius* , a self-incompatible tree, and in shrubby, self-compatible *Myrcia rhodosepala*. This flowering strategy differs from the previous one in that although the number of days flowers are open may be similar to the 'big-bang' strategy, in the 'pulsed-bang' flowering is discontinuous and there may be an interval of several days when no flowers open. Synchronization of actual flowering days is perfect. In *Eugenia parnahybensis,* a locally common campo sujo shrub, the pulsed-bang strategy is perfected to such a degree that it appears that the whole population is in flower only two days a year on which the campo sujo is dotted with their white flowers. It is not surprising that, although a common plant, flowering material had not previously been collected in the Distrito Federal. This 'pulsed-bang' strategy should not be confused with Gentry's 'multiple bang' where there are several small-scale flowering episodes throughout the year, each involving an intermediate sterile phase and the formation of a new inflorescence.

B) A cornucopia flowering strategy, e. g., many flowers being produced for over a month, is exhibited by the self-incompatible tree *Siphoneugena densiflora.*

C) A steady-state flowering strategy , e. g., a small number of flowers produced over a long period of time, is exhibited by shrubby, self-compatible *Psidium firmum* and also shrubby, partially self-compatible *Myrcia linearifolia,* probably associated to trapline behaviour by the *Bombus* pollinators. Field experience suggests that many other species of *Myrcia* also have this flowering strategy.

The intriguing question of what triggers such precisely synchronized flowering as in the big-bang and pulsed-bang naturally comes to mind. There appears to be a correlation between flowering and relative humidity of the air

(Fig. 2.18).

Sudden increases, rather that absolute values, appear to trigger flowering in the big bang species. *Eugenia dysenterica* and *Campomanesia pubescens* flowered on the same day when mean humidity was 46 % and an increase of +12 % had occurred since the previous day (which was the driest day of the year). The third big bang species, *Campomanesia velutina,* flowered on a day humidity was 89 % and an increase of + 8 % from the previous day had occurred and this was also one day after the largest daily increase of the year (+ 42 %) had been registered.

The synchronization of pulsed bang species may be more complex. *Myrcia rhodosepala* showed no discernible pattern of flowering. *Blepharocalyx salicifolius* commenced flowering the day after the largest daily increase of the year, of + 42 %, had been registered and thereafter opened flowers on all days in which humidity was high (c. 80 % or higher) until all buds had opened.

I should add, perhaps, that abrupt increases in humidity tend to diminish towards the end of the dry season. In 1988, July had eight days when increases above + 5 % occured, August had four and September had five, three of which occured in the last week, after the rains had started (Pereira Neto 1988), and triggered flowering in the three big-bang species and one pulsed bang species.

The flowering of cornucopia and steady state species showed no correlation with daily changes in humidity or other environmental conditions such as temperature, rainfall, etc. *Siphoneugena densiflora* and *Psidium firmum* started flowered in August, when sudden increases of humidity occured less frequently.

The big bang species are thus effectively flowering at the threshold of the rainy season. As can be seen by comparing figures 2.19 and 2.21 of humidity in the months before and after, the transition of dry to rainy season is the period of the year when the strongest fluctuations of humidity occur in the shortest time intervals and is probably when there is greater scope for humidity-linked synchronization. Judging by the literature (reviewed in the Introductory Chapter) flowering at the begining of the rainy season is one of the preferred strategies within the family and occurred in 7 out of 10 species investigated in South American forest habitats (Ferreira & Merona 1987, Frankie & al. 1983, Morellato *et al.* 1989). In the present study, 6 out of 8 (all cerrado species except

for *Campomanesia velutina*) commenced flowering at the beginning of the rainy season.

Dates on flowering collections and field experience with other Distrito Federal species indicate that most cerrado species flower somewhere around the dry-to-wet seasonal transition, but that Gallery forest species usually flower around the opposite seasonal transition (wet-to-dry).

Fig. 2.19 - Daily variation in mean relative humidity of the air during the months of May, June and July in the Distrito Federal

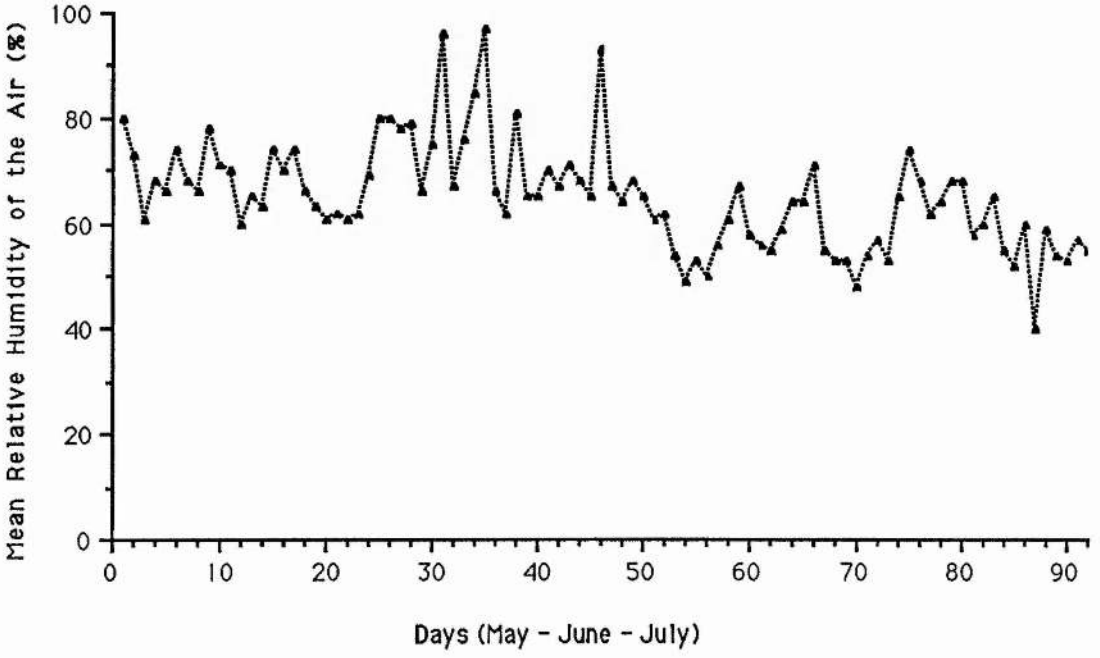


Fig. 2.20 - Daily variation in mean relative humidity of the air during the months of August, September and October in the Distrito Federal

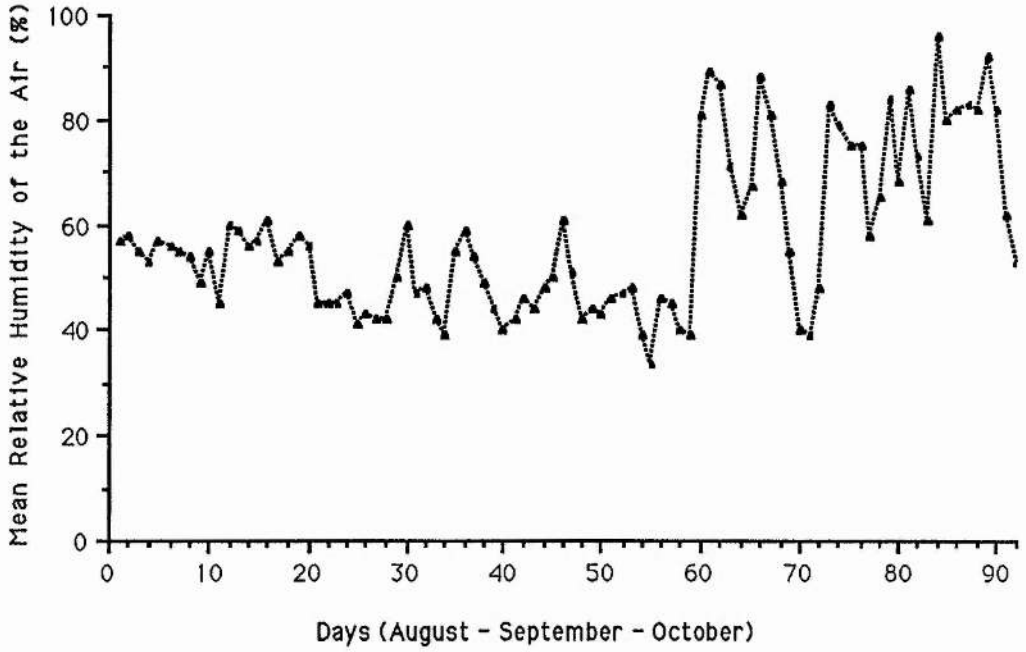
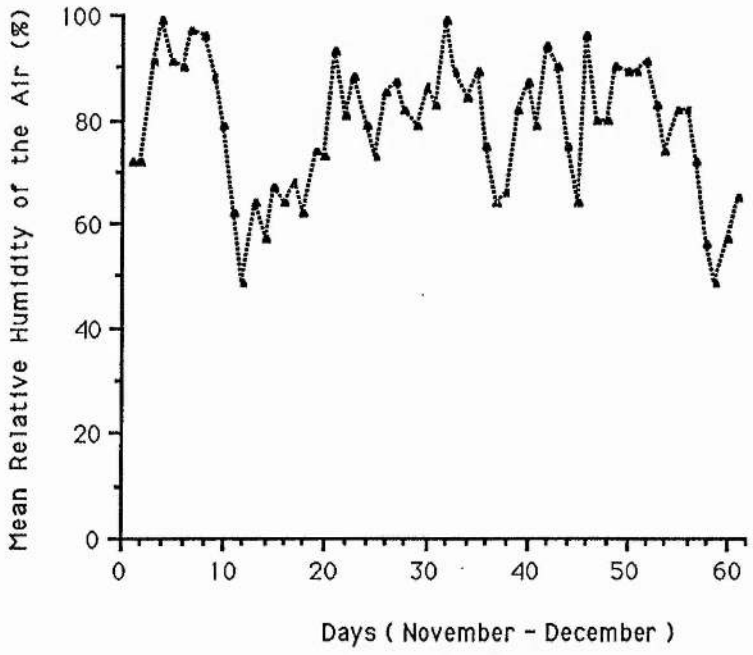


Fig. 2.21 - Daily variation in mean relative humidity of the air during the months of November and December in the Distrito Federal



2.3.4 Floral morphology

There are certain floral characteristics that have long been used taxonomically without any knowledge of their function. During my investigations, mainly of floral biology, some explanations have presented themselves to me, albeit open to confirmation. In a large family so notoriously poor in good taxonomic characters it is to be hoped that a better understanding of the adaptive function will be of aid in the choice of reliable characters.

A) More ovules than will be matured into seeds are present in the ovary

The question 'Why do plants have more ovules than they will mature into seed? has been answered in several ways, e. g., extra ovules give the plant an opportunity to exercise female choice and select the best, most vigorously growing zygotes (Stephenson & Bertin 1983), extra ovules are relicts from ancestors that had other dispersal mechanisms (Casper & Wiens 1981), extra ovules constitute insurance that, in presumably sporadic optimum physiological

conditions, the plant does not lack ovules to maximize seed-set ('bet-hedging').

Another theory, which may apply to this group, is that species with ovular self-incompatibility mechanisms may have to maintain 'superfluous' ovules to ensure that a minimum number of seeds will be fertilized, this minimum number being probably related to the dispersal mechanism and to female investment in the fruit. In ovular self-incompatibility mechanisms self pollen tubes may occupy ovules, thereby preventing later cross pollen tubes from penetrating them (Lewis 1949). It is therefore more wasteful of ovules than the better known self-incompatibility mechanisms in which the barrier is either in the stigma (such as in Cruciferae and Compositae) or in the style (Leguminosae and others) and ovules are never penetrated except by compatible pollen tubes. A survey of the species cited by Seavey & Bawa (1986) which have late-acting self-incompatibility showed that most of them have a large number of ovules and produce many-seeded fruits, making it hard to discover if they are potentially capable of maturing all their ovules except by *ad hoc* experiments. Some however, resemble Myrtaceae in having one- or few-seeded fruits derived from multi-ovulate ovaries.

It is interesting that the only Neotropical genus of Myrtaceae in which the ovules are reduced to the 1- 2 that will develop into seeds (*Pimenta*) is also known for having dioecious species, e. g. *P. dioica* (Chapman 1964) and probably *P. guatemalensis* (Landrum 1986). It is tempting to surmise that in the case of these species of *Pimenta* there is no need of 'superfluous' ovules, since all pollen tubes to grow down the style will be cross pollen tubes.

B) Type of Stigma

This interesting character was usually cited in 19th century monographs (Cambessèdes 1829) but has now fallen in disuse so that even high-quality descriptions by modern botanists usually ignore it (Kawasaki 1989, Landrum 1984, Rotman 1976) or only cite it if the stigma is strikingly enlarged (Landrum 1986, 1988).

In the species here investigated I found that stigma size is correlated to the number of ovules in the ovary, probably because it will need to support more germinating pollen grains.

Table 2.21 - Correlations between stigma diameters and ovule numbers

Species (max. no. of pollen tubes)	**(stigma diameter in mm)**	**(max. no. of ovules)**
Eugeniinae		
Eugenia dysenterica (± 15)	**0.1**	**8 (n=3 fls)**
Siphoneugena densiflora (± 15)	**0.1**	**13 (n=3 fls)**
Myrciinae		
Myrcia linearifolia (17)	**0.1**	**4 (n=3 fls)**
M. rhodosepala (10)	**0.1**	**6 (n=3 fls)**
Myrtinae		
C. pubescens (± 20)	**0.74**	**78 (n=6 fls)**
Psidium firmum (± 120)	**0.65**	**298 (n=3 fls)**
C. velutina (± 50)	**0.57**	**29 (n=4 fls)**
B. salicifolius (± 35)	**0.1**	**12 (n=8 fls)**

It is of interest in this context that in a recent monograph of *Pimenta* (Landrum 1986) a peltate stigma is cited for *P. dioica* and *P. guatemalensis* only (Landrum did not specifically say that the stigma was non-peltate in the other species, but I assume the character was only striking enough to seem worth mentioning in these two species). Since both species have 1 or 2 ovules in the ovary, this would apparently contradict the idea of larger stigmatic areas being correlated with a large number of ovules.

P. dioica is dioecious with ungerminable pollen (Chapman 1964) in the female flowers and in the description of *P. guatemalensis* Landrum (1986) stated that 'indivduals in which the ovaries have no locules' were to be found, which certainly seems to indicate that it might also be dioecious. Why should dioecious species only have large, peltate stigmas?

One possibility is that once the female flowers own pollen becomes ungerminable, it becomes solely dependent upon stigma-pollinator contact for pollen and expands to the optimum size for collecting pollen grains from the pollinator's body. If it was previously a self-compatible species, a minute stigma might have previously avoided contact with its own anthers and therefore

increased outbreeding; if it was a self-incompatible species, a minute stigma might have avoided an excess of self-pollen tubes which might have occupied all the ovules and resulted in the abortion of the pistil.

Botanists are urged to include type of stigma in their descriptions. This seemingly insignificant character both provides an insight into the biology of the plant and, in some cases, can be used in keys as an alternative character to number of ovules, with the practical advantage of not requiring dissection of the ovary.

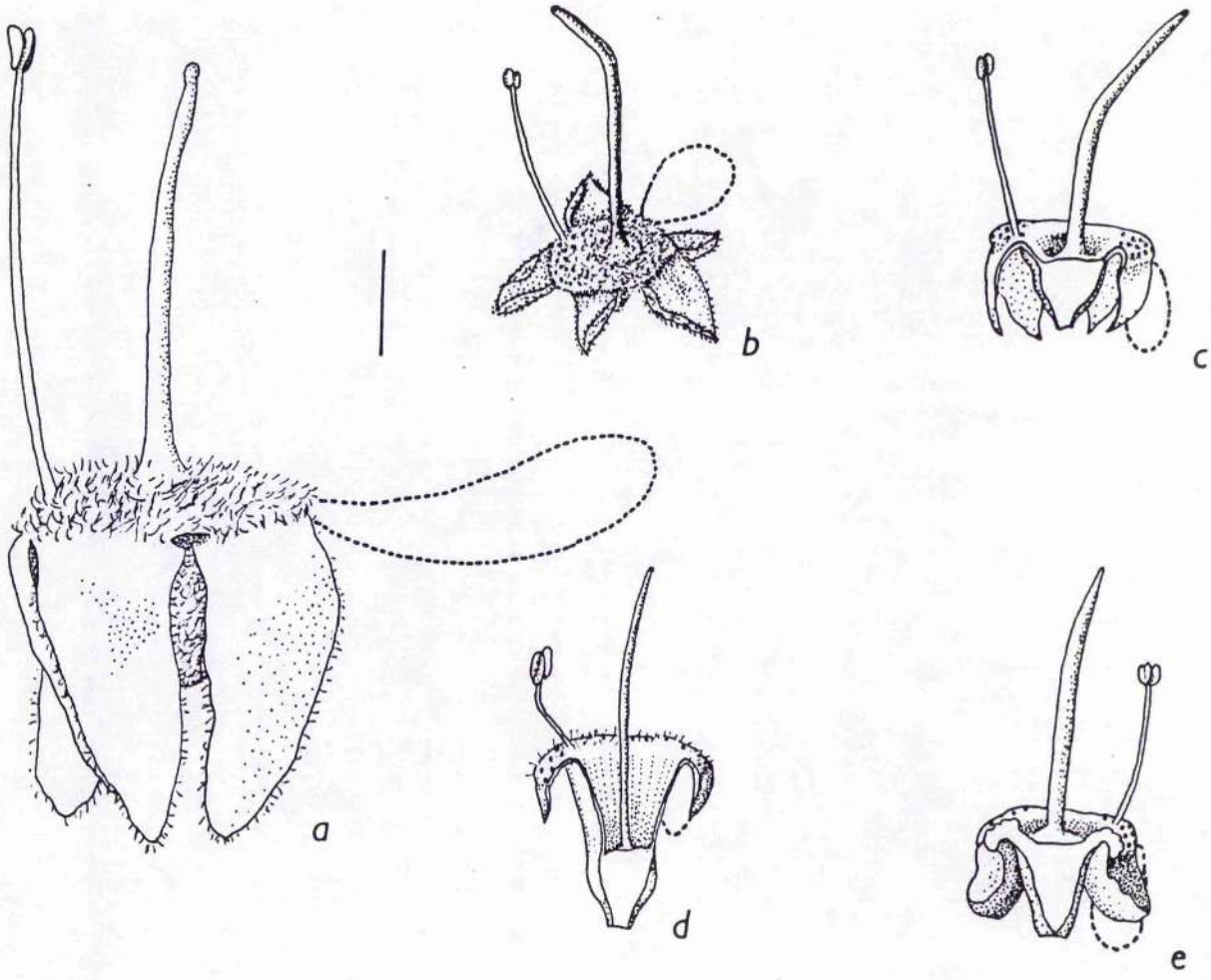
C) Hypanthial Cup and Buzz Pollination

Whether the hypanthium is prolonged or not into a cup above the top of the ovary has played an important part in the delimitation of many American genera of Myrtaceae (Berg 1857). In the hypogynous Myrtaceae, such a cup raises the staminal disk above the level of stylar insertion and reflexes the sepals and petals (Fig 2.22). Some of these, such as *Gomidesia* (Legrand 1958) and *Siphoneugena* (Proenca 1990), appear to be good genera in which the prolonged hypanthium cup is well correlated with other characters. Others, such as *Aulomyrcia,* have proved to have transitional species with intermediate or almost imperceptible hypanthium cups and in the absence of other distinguishing characters have not been maintained by most modern botanists (McVaugh 1968, Legrand 1969, Kawasaki 1989).

Hypanthial cups are to be found in many species of Myrtaceae throughout the range of the family. In the bird-pollinated species of *Eucalyptus* the function of the cup is probably to accumulate the large quantities of nectar produced (Bond & Brown 1979, Ford & Paton 1982) - in cupless and also bird-pollinated *Darwinia* (Myrtaceae) this function is taken over by a ring of tightly imbricate petals (Briggs 1964) which are absent in *Eucalyptus* .

Of the eight species I studied, none produced nectar yet *Siphoneugena densiflora* has a very prolonged hypanthium cup and *Myrcia rhodosepala* and *Blepharocalyx salicifolius* a short one (see Table 2.22). All three species are buzz-pollinated. *Siphoneugena densiflora* is exclusively buzz-pollinated by *Ptiloglossa* bees, while in the other two species visiting bees showed both buzzing and gleaning behaviour. *Blepharocalyx suaveolens* is commonly visited by a large number of species of bees, some of which showed gleaning behaviour

Fig. 2.22 - Flowers fixed in the field with all but one stamen removed to show hypanthial cup



(scale bar equals 2 mm) (a) *Campomanesia velutina* (b) *Myrcia linearifolia* (c) *M. rhodosepala* (d) *Siphoneugena densiflora* (e) *Blepharocalyx salicifolius* a & b are glean-pollinated; c, d & e are buzz-pollinated.

and some of which buzzing behaviour. In *Myrcia rhodosepala,* several *Bombus* bees simultaneously foraging in a newly-opened inflorescence (6:30 a. m.) all showed buzzing behaviour while late, solitary arrivals (8:00 a. m.) showed gleaning behaviour and soon flew off. I did not observe bees to attempt buzz pollination of the other species which do not have prolonged hypanthium cups.

One of the species which does not have a hypanthium cup is a congener of *Myrcia rhodosepala, M. linearifolia.* The two species have flowers of aproximately the same size, are in flower simultaneously and occur in the same kind of vegetation. They are both pollinated by *Bombus morio,* yet I observed this bee to vibrate in *Myrcia rhodosepala* but not in *M. linearifolia.*

The significance of the hypanthial cup in bee-pollinated species, which usually provide pollen as a reward, is not known. The cup could be interpreted as a mere relict from nectar producing ancestors, now functionless. The data in Table 2.22 however, although subject to further more detailed investigation, suggests that it could also contribute towards buzz pollination. Two possible explanations of how the cup might contribute to buzz pollination are presented below.

Bees need to be firmly anchored while buzzing or they dislodge themselves by the vibrations (Buchmann 1983). In the buzz-pollinated Myrtaceae I observed the circular disc at the apex of the hypanthial cup is slightly curved and could act as a 'hold' for the bee to grasp; the cupless flowers had flat, square or pentagonal disks which provided no hold. Cinematographic video or film techniques are needed to test this hypothesis, since it is very difficult to exactly follow the bees' movements during the one second or so of buzzing behaviour.

Table 2.22 - Number and kind of visits by bees capable of buzzing* observed for several species of Myrtaceae from the Distrito Federal

B = buzzing visit to 1 or more flowers, G = gleaning visit to 1 or more flowers; c = visitor captured; underline indicates an isolated incident out of the observation time

Species (Total time observed)	Proportion of Buzzing to Gleaning visits related to hypanthial cup	Visitors
Blepharocalyx salicifolius (H.B. K.) Berg (60 min.)	4 B / 2 G - short cup	*Ceratilictus theius* (Schrottky) 1 ?c *Melipona quinquefasciata* Lep. 2Bc *Bombus atratus* (Swederes) ? 2 G + 1 B *Centris violaceus* ? 1 B
Campomanesia pubescens (DC.) Berg (30 min.)	2 G + 1 G - cupless	*Bombus* spp. 2 G + 1 G
C. velutina Berg (60 min.)	2 G - cupless	*Bombus morio* Frankin 1 Gc *Bombus atratus* (Swederes) ? 1 G
Eugenia dysenterica Mart. ex DC. (45 min.)	2 G + 1 G - cupless	*Bombus* spp. 2 G *Melipona, Ceratina?* 1 G
M. linearifolia Camb. (180 minutes)	3 G - cupless	*Bombus atratus* (Swederes) 1 Gc + 1 G *Bombus morio* Franklin 1 Gc
M. rhodosepala Kiaersk. (120 minutes)	8 B / 2 G - short cup	*Bombus morio* Franklin 2 Bc *Xylocopa ciliata* Burmeister 1 Bc + 1 B *Bombus* spp. 4 B + 2 G
Psidium firmum Berg (180 minutes)	6 G - cupless	*Ceratina gossypii* Schrottky 1 Gc *Bombus* spp. 5 G
Siphoneugena densiflora Berg (590 minutes)	9 B - long cup	*Ptiloglossa* sp. 1 Bc + 8 B
Myrcia torta (Berg) Mattos & Legrand (not under observation)	1 B - short cup	*Augochloropsis, Ceratilictus?* 1 B

* visits by *Apis mellifera* (introduced), *Trigona* spp, *Partamona cupira* and *Scaptotrigona postica* (pollen thieves) have been excluded.

Another possibility is that the function of the cup is to substitute the usual 'petaloid' floral display for a 'staminal' floral display, the reason for this being that the hypanthial cup not only curves the staminal disc but also reflexes the sepals and petals so that they are hidden from view by the outer whorls of stamens. In contrast, cupless species have the four or five petals conspicuously

arranged around the flat disc; the sepals usually support the petals but are sometimes reflexed (Fig. 2.23).

If the floral cue hypothesis is accepted, it would provide an explanation for a tendency in Myrtaceae towards complete closing of the buds. These totally closed buds open by a circular calyptra, the petals being either supressed or vestigial and adnate to the inner surface of the calyptra. Such flowers occur in the genus *Calyptranthes* and in a few species of distantly related *Myrceugenia* (Landrum 1984), *Psidium* (McVaugh 1968), *Campomanesia* (Landrum 1986) and *Siphoneugena* (Proença 1990). Landrum (1984) has stated that such closed buds could have evolved as a protection against staminal predation by insects. An alternative explanation is that they provide a energetically cheap way of switching from a 'petaloid' to a 'staminal' floral cue.

If a prolonged hypanthial cup with reflexed sepals and petals is indicative of buzz pollination in Myrtaceae, one could conservatively estimate that about half of tribe Myrtoideae is probably buzz-pollinated, which adds a staggering 1,500 species to the list of buzz-pollinated taxa in the Neotropics.

D) Anther dehiscence and buzz-pollination

Buzz pollination is almost exclusively restricted to taxa with poricidal anthers (Buchmann 1983) so it came as a considerable surprise to find that the three species of Myrtaceae which are buzz pollinated have longitudinally dehiscencing anthers. Buchmann (1983) did not include the Myrtaceae in his list of families possibly exhibiting buzz-pollination because the taxa of that family which have non-longitudinal dehiscence of the anthers were not 'truly poricidal' but 'valvate'. In that author's experience, such valvate anthers are usually associated with 'sticky, clumpy pollen' which is not readily removed from the anthers by buzzing. Actually, all myrtaceous pollen falls perfectly into the type and size given by Buchmann (1983) for pollen adapted for removal from the anthers by buzzing. A palynological survey of 140 species of trees from Southern Brazil revealed that the family is stenopalynous, with the axial lengths varying between 16.5 and 38 μm and a smooth or granulate, non-ornamented exine (Barth & Barbosa 1972, also Stellfeld 1968).

The genus with 'valvate' anthers (*Gomidesia*) presents an interesting trend

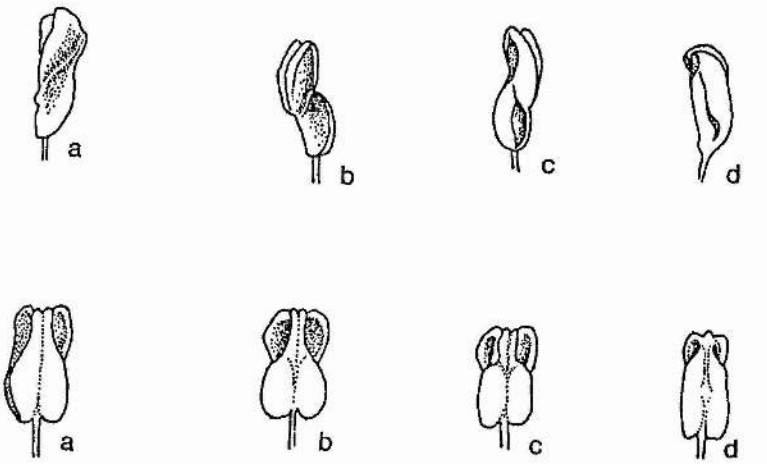
towards poricidal anthers (Fig. 2.23). In the most primitive species, the anther is bent in such a way that the longitudinal slit is S-shaped and the upper part of the slit is extrorse and gapes much more than the lower one. In intermediate species, the anthers are more sharply bent and the locules are twisted and connected so that the lower part of the slit is completely closed by the overlapping margins making the anthers functionally poricidal (Legrand 1958). Finally, in *Gomidesia cerqueirea* Legrand the anthers are straight and the lower part of the slit never opens, with dehiscence occurring by four apical pores.

Buzz-pollination in flowers with longitudinally-dehiscing anthers has also been recently detected in five species of *Diplusodon,* Lythraceae (Barros 1989) and in two species of *Kielmeyera,* Guttiferae (Oliveira & Sazima 1990). This seems to suggest that buzz pollination could actually be much more widespread than the 6-8% of Angiosperms predicted by Buchmann (1983) on the basis of poricidal anthers alone.

Buzzing behaviour may, therfore, be much older than is commonly thought (Proença 1991). Poricidal anthers do not appear in the fossil record until the upper Paleocene (Friis & Crepet 1987) but the first recordings of Myrtalean pollen are Cretaceous, e. g. Cenomanian (Muller 1984), Santonian (Crepet 1984) and possibly Coniacian (Penny 1969). Myrtalean flowers somewhat similar to modern *Leptospermum* also appear in the fossil record in the Cenomanian and the Turonian - Campanian (Friis & Crepet 1987).

Present-day Myrtales known to have buzz pollination thus comprises Myrtaceae, Lythraceae and Melastomataceae (including Memecylaceae). Lythraceae, like Myrtaceae, has both taxa with poricidal (Buchmann 1983) and longitudinally-dehiscing anthers (Barros 1989). Melastomataceae, usually with poricidal anthers, is probably the largest exclusively buzz-pollinated family in the world (ca. 4,000 species) and may represent the end result of a long history of successful coevolution and adaptation to buzzing pollinators from primitive Myrtalean ancestors. Melastomataceae are pollinated by a wide range of vibrating bees (Renner 1989) and this author has recently advanced the theory that eastern and western Gondwanan lineages of Melastomataceae and Memecylaceae coevolved in parallel with the earliest bees in the lower mid-Cretaceous.

Fig. 2.23 - Anthers of selected *Gomidesia* species showing trend to poricidal (redrawn from Legrand 1958)



(a) *G. schaueriana* Berg. (b) *G. sellowiana* Berg. (c) *G. eriocalyx* (DC.) Berg. (d) *G. affinis* (Camb.) Legrand.

A Cretaceous origin for Myrtalean buzz pollination is furthermore supported by the biogeography and ecology of the Colletidae bee family. Both Myrtaceae and Colletidae are probably of southern gondwanan origin (Michener 1979, Johnson & Briggs 1984). The Colletidae are the most primitive flower-visiting bees and are believed to have diverged in the upper Cretaceous. They are strongly oligolectic within Myrtaceae in modern-day Australia (Michener 1965) and also seem to be associated to Neotropical Myrtaceae (Frankie et al. 1983 this study) although *Ptiloglossa* also visits non-Myrtaceae (Oliveira & Sazima 1990). Such a close association at a high taxonomic level (i. e., family to family) is unusual and suggests coevolution with mutual specialization early on in the history of both. In tribe Memecyleae of the Melastomataceae a very specialized form of buzz-pollination has arisen and the anthers have elaiaphors which produce an oil that is collected by Euglossinae and Halictidae bees along with the pollen (Buchmann & Buchmann 1977) although Renner (1989) states she never saw bees collecting this oil and believes its function is merely aroma producing.

E) Trend towards reduction in the number of ovules in the ovary

This is a marked trend within Myrtaceae. Two non-exclusive hypotheses to explain this tendency are presented:

1) Reduction of the number of ovules associated to reduction in the number of seeds per fruit to one as an adaptation to avian dispersal

Most species of the primitive subtribe Myrtinae have fruits with several to many seeds but in the more advanced Subtribes Eugeniinae and Myrciinae one-seeded fruits are the norm. The advantage of 'packaging each seed separately' is that the plant can then mature the fruits at different rates, which probably means more dispersal events for the same number of seeds. It also gives the plant a chance to selectively abort fruits with inferior zygotes on an individual basis, which is impossible in many-seeded fruits where an over-all inferior fruit (e. g., with few zygotes or mostly slow-growing, weak ones) may easily include one or two superior zygotes which will be sacrificied when the fruit is aborted.

Subtribe Myrtinae probably has both mammal and bird dispersed species. *Psidium* is cited by Snow (1983) as being consumed by specialized frugivorous birds, but my observations in the Distrito Federal suggest that *Psidium firmum*

(see discussion of the reproductive biology of that species) may be dispersed by small rodents; cultivated *P. guajava* is eaten by parrots (Maria Alves, personal communication), other birds (Advani 1981) and bats (Advani 1982, Funmilayo 1980). *Campomanesia* was also cited by Snow (1983) as being consumed by specialized frugivorous birds but Landrum (1986) has pointed out that most species of *Campomanesia* best fit the mammal-dispersed syndrome [as proposed by Janson (1983) based on an Amazon community]. *Calycolpus* is consumed by both specialized and unspecialized frugivorous birds (Snow 1983).

In the other two Subtribes, *Eugenia* is cited as consumed by unspecialized frugivorous birds (Snow 1983); two unidentified species of *Eugenia* from Costa Rica are eaten by *Pharomachrus mocinno* (Trogonidae) and by *Aulacorhynchus prasinus* (Rhamphastidae) (Wheelwright & *al.* 1984). Fruits of shrubby *Eugenia punicifolia* are probably consumed by birds belonging to the Tinamidae (see taxonomic discussion of that species). In the Distrito Federal, fruits of arboreal *Siphoneugena densiflora* are eaten by *Miyarchus swansonii* (Tyrannidae), an oportunistic fly-catcher and by other birds (Paulo Antas, personal communication). Fruits of *Myrcia torta* are eaten by *Neothraups fasciata* (Emberezidae), a generalist low-foraging tananger (Alves 1991?).

On the basis of this hypothesis, ovule reduction is associated with fleshy, few-seeded fruits which are dispersed by birds or occasionally mammals.

2) Reduction of the number of ovules per ovary as a response to predation by larvae of Tephritidae flies.

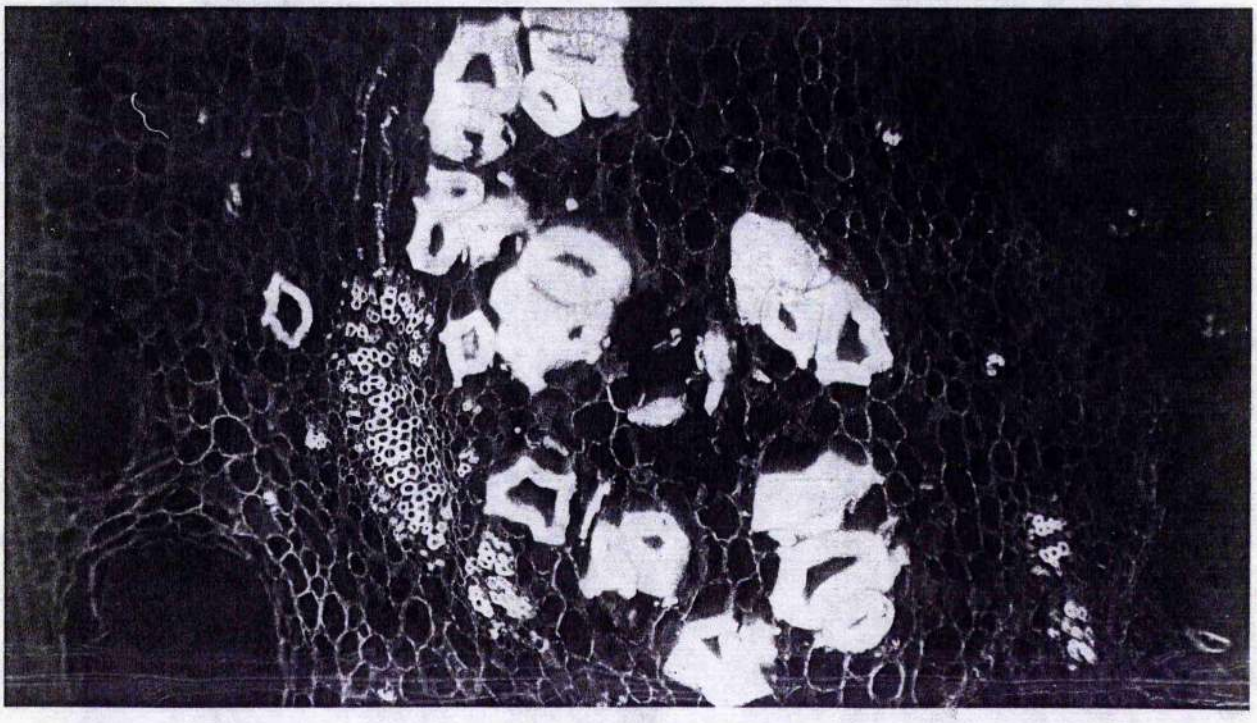
The selective pressure of this kind of predation has been demonstrated very effectively in Berberidaceae by comparing two different populations of *Berberis hispanica* (Herrera 1984), one which had the tephritid parasite and one that did not (due to climatic conditions associated with high altitude). The parasite consumes only the ovules and Herrera found that larvae had a much higher mortality (probably due to starvation) in few-ovuled flowers than in many ovuled-flowers. Also, the population which had the parasite had significantly less seeds per fruit than the non-infected population, suggesting that co-evolution with the parasite was acting to reduce the number of ovules in the ovary and thus reduce the population of the parasite.

Predation by Tephritidae flies in Myrtaceae occurs in *Eugenia uniflora* (Burk 1983), *Eugenia javanica* (Tan & Lee 1982) and especially in *Psidium*

guajava (Burk 1983, Malavasi & Morgante 1980, Malavasi et al. 1983, Morgante & Malavasi 1981). In Brazil it is the biggest problem to affect large-scale cultivation of the latter.

It is interesting that the two genera with the highest number of seeds per fruit, *Psidium* and *Campomanesia,* have some form of mechanical barrier within the fruit which is lacking in most other genera. *Psidium* has stone cells scattered in the ovarian tissue (such as occurs in the pear *Pyrus malus*) which may act as mechanical blocks to the ovipositors of the flies (Fig. 2.24) and seeds with hard, bony seed coats (Landrum & Sharp 1989). *Psidium* has 2-5 locules in the ovary and each locule can mature few to many seeds. In *Campomanesia,* the fruits may have up to 18 locules (Landrum 1986) but only 1 ovule per locule matures and the locule wall forms a glandular pseudo-testa which is 'bitter if chewed and smells of turpentine' (Landrum 1982), the true testa being a thin membrane. I have observed that in *C. pubescens* this locule wall develops even if there is no seed inside. The locule wall might thus act as a trap for developing larvae and stop them from passing on to the other healthy locules.

Fig 2.24 - Stone cells in ovary of *Psidium firmum* (fluorescing white).



CHAPTER 3 - BIOLOGICAL HISTORY, DISTRIBUTION AND ECOLOGY

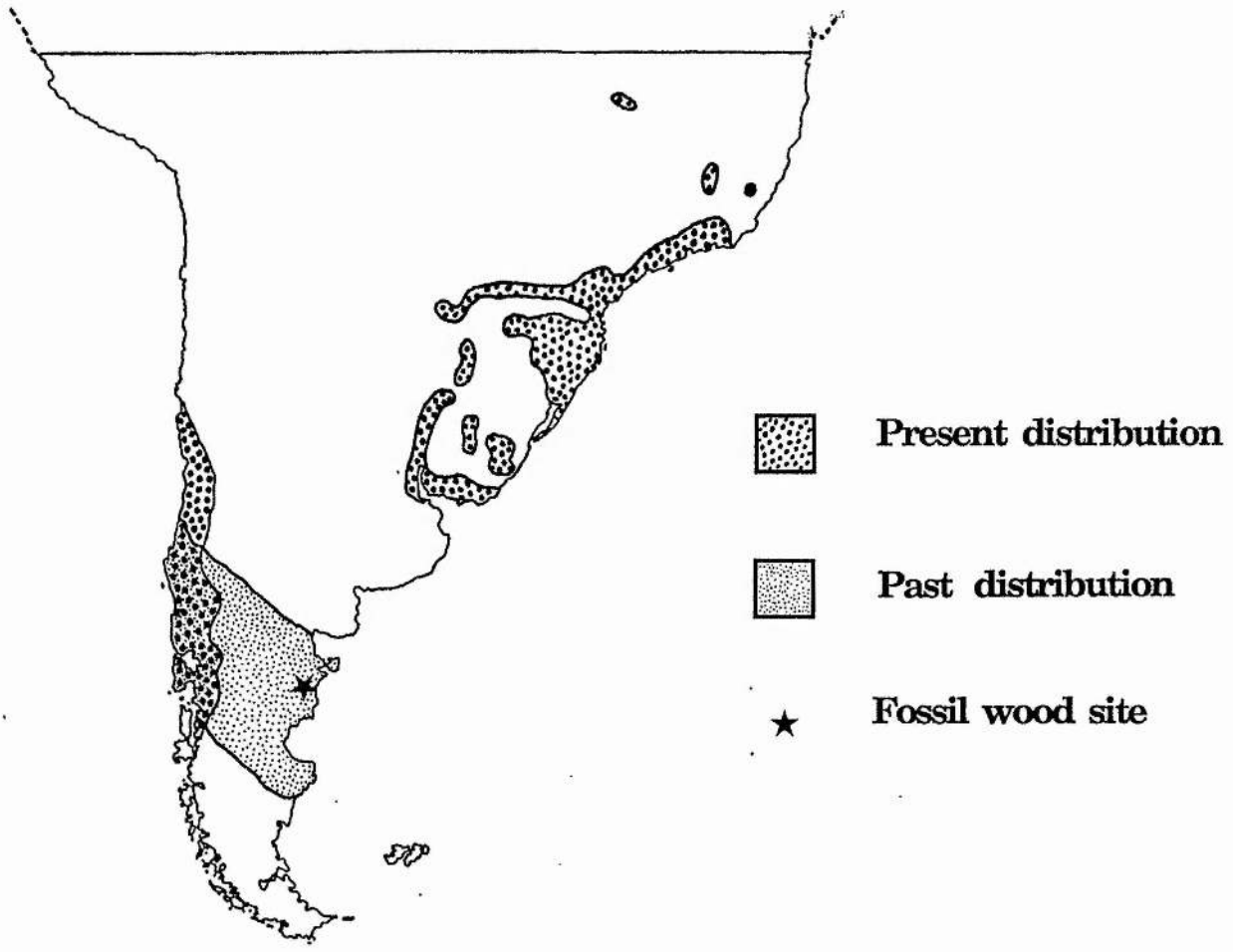
The predominantly southerly distribution of the Myrtaceae is so conspicuous that botanists have realized for some time that the family had probably originated in the Southern Hemisphere (Bentham 1869; Berry 1915). The view that the Myrtaceae had a southern Gondwanan origin has since become generally accepted by most modern authors (McVaugh 1968, Johnson & Briggs 1981, Gentry 1982).

The Myrtaceae is probably the oldest family in its order (Raven & Axelrod 1974) and has been registered in the Cretaceous palynofloras of South America, Africa and Borneo (Muller 1981). Fossil pollen indicates that the family dates at least from Santonian times in the middle of the Late Cretaceous (Crepet 1981, Muller 1984) and possibly back to the early Late Cretaceous, i. e., Cenomanian (Penny 1969). The Santonian-Campanian fossil angiosperm flora is actually dominated by taxa with small, epigynous, pentamerous flowers not unlike those of the Myrtaceae but it is in the Maastrichtian, at the close of the Cretaceous, that flowers and pollen of Myrtaceae are especially well represented (Friis & Crepet 1987).

In Australia, the Myrtaceae first appears in the fossil record in the Paleocene (Stover & Partridge 1973) but the family did not reach its present dominance until the Miocene. The rise to dominance of the Myrtaceae in Australia coincided with the reduction of *Nothofagus* forest (which now only exists in the subtropical southeast of that Continent). This is proposed to have been possibly associated with increasingly arid conditions allied to infertile soils whilst in wetter Borneo it may have been linked exclusively to an increase in areas with infertile soil through erosion and exposure of Tertiary sandstone (Martin 1982). *Eucalyptus* -like pollen is present but not dominant in the Australian Miocene and the myrtaceous pollen assemblage of that period is more similar to that of modern *Tristania, Backhousia, Baeckea, Syzigium, Acmena* and others (Martin 1982). The present-day dominance of *Eucalyptus* in Australia is thought to be a relatively recent Pleistocene phenomenon (Kershaw 1986, Singh & Gleisser 1985).

In the Americas, Landrum (1981) proposed that *Myrceugenia* probably grew from coast to coast and was already somewhat diverse in a humid, temperate Paleocene forest that covered the southern tip of South America. This hypothesis, based on present-day geographical distribution, phylogeny and ecology of *Myrceugenia,* was independently confirmed by the discovery of fossil Paleocene wood believed to belong to that genus (Ragonese 1981) from the area (Fig. 3.1). The biogeography and ecology of *Siphoneugena* is somewhat similar to *Myrceugenia* (Proença 1986) and suggests that it also existed in this early forest.

Fig. 3.1 - Present and hypothetical past distribution of Myrceugenia (redrawn from Landrum 1981)



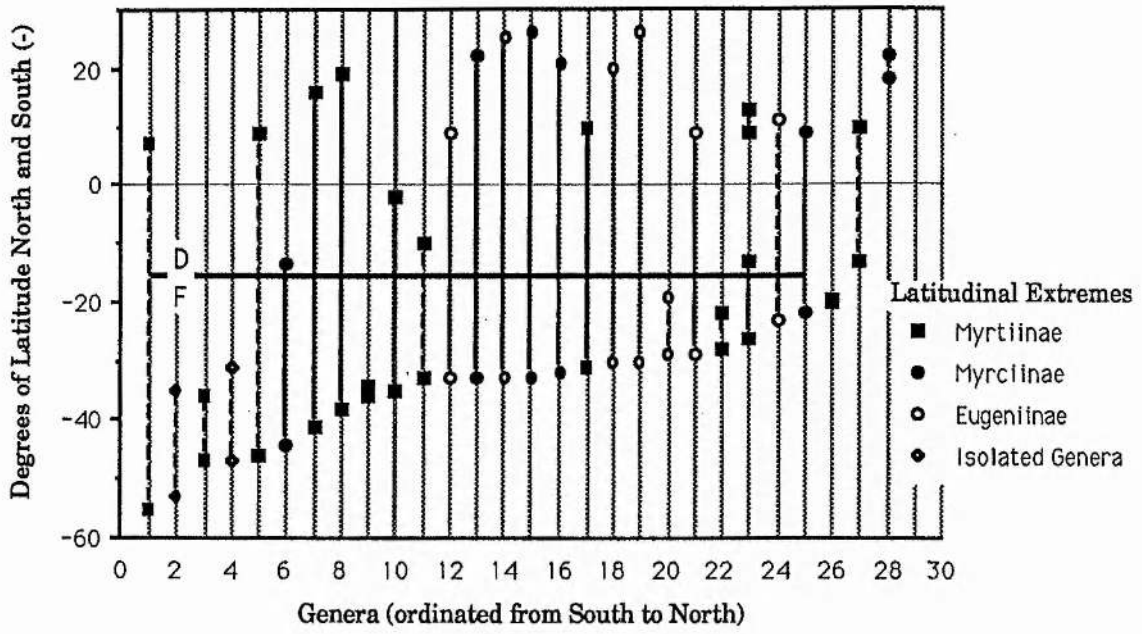
This forest subsequently contracted due to climatic events linked to the elevation of the Andes (see Landrum 1981 for a clear, well-documented reconstruction) but persists mostly west of the Andes in Central Chile and in Southeastern Brazil. It has also managed to survive (and to expand northwards) within a narrow altitudinal band along the eastern foothills of the Andes where conditions are cool and moist enough. It is in these three forest remnants that the Myrtaceae are now most strikingly represented in ecological importance and in diversity (respectively Figs. 3.3 & 3.4). In an assessment of frost damage to southern cerrado species (Silberbauer-Gottsberger & al. 1977), these authors found a close correlation between frost damage and the distribution of the species or in some cases the genera, e. g., typically Amazon-centered genera such as *Miconia* (Melastomataceae) and *Xylopia* (Annonaceae) had high frost damage, above 70%. The three Myrtaceae investigated, respectively, *Myrcia lasiantha, Eugenia aurata* and *Psidium* sp. showed moderate (below 10%) frost damage, with the more southerly *Psidium* the least damaged of the three. This is further evidence of a southerly center of origin, at least for these genera.

Although it is possible that the Myrtaceae was already an important family in the temperate, Paleocene forest, another possibility is that they were able to speciate under the changing climatic conditions of the Pleistocene and have radiated only recently. This would parallel the Australian radiation of *Eucalyptus* although on a much smaller scale.

During the remainder of the Tertiary, the family advanced northwards into Asia, Europe and North America. There are two records of North-American Myrtaceae from the Paleocene, one from California and one from Saskatchewan. But most American myrtaceous fossil pollens date from the Eocene when the family seems to have been more or less widespread in the Southern States, e. g. Texas, California, Mississipi, Alabama, Tenessee, Colorado, Utah and Wyoming. Leaves identified as belonging to *Eugenia* have been found in Eocene beds in Arkansas, Wyoming and Colorado. There are also records of myrtaceous pollen in Eocene beds of the Amuroblast of Russia (Fedotov 1981) and of Europe (Krutzsch 1967). The modern distribution of the Myrtaceae is still predominantly in the Southern Hemisphere but the family does reach up into Eastern China, Central Mexico and Southern Florida, with one species, *Myrtus communis,* growing in Northern Africa and Southern Europe.

At present, the 28 genera of Neotropical Myrtaceae occur between latitudes of 55 ^{o} S and 26 ^{o} N (Fig. 3.2).

Fig. 3.2 - Latitudinal ranges of neotropical Myrtaceae



Genera represented (from right to left): 1 *Myrteola,* 2 *Tepualia,* 3 *Amomyrtus,* 4 *Luma,* 5 *Ugni,* **6 *Myrceugenia,* 7 *Blepharocalyx,* 8 *Psidium,*** 9 *Legrandia,* 10 *Myrrhinium,* 11 *Acca,* **12 *Myrciaria,* 13 *Myrcia,* 14 *Eugenia,* 15 *Calyptranthes,* 16 *Gomidesia,* 17 *Campomanesia,*** 18*Calycorectes,* 19 *Myrcianthes,* 20 *Neomitranthes,* **21 *Siphoneugena,*** 22 *Amomyrtella,* **23 *Pimenta,*** 24 *Plinia,* **25 *Marlierea,*** 26 *Accara,* 27*Calycolpus,* 28 *Mitranthes* (Distrito Federal genera, represented in the graph by continuous lines, are in **bold type**).

The ecological importance of the Myrtaceae in present-day South America seems to reach a peak where there is a combination of coolish temperatures, a steady supply of water and poor, weakly acidic soil.

Flooding can increase the family's importance rather than the reverse and the literature is full of references to Myrtaceae dominating flooded communities world-wide (Table 3.1). Such flooded communities usually have poor soils, e. g. 'on white sand' (Keel & Prance 1979), 'soil is peaty, very acid and nutrient-poor' (Kartawinata 1980). Some species are specialized in growing below flood level along river banks ('rheophytes') such as *Metrosideros angustifolia* (Van Steenis 1978), *Myrciaria dubia* (Keel & Prance 1979), *Eugenia inundata* (Stephen Harris, personal communication) and *Marlierea* sp. (personal observation).

Fig. 3.3 - Ecological importance of Myrtaceae in various non-flooded South American communities

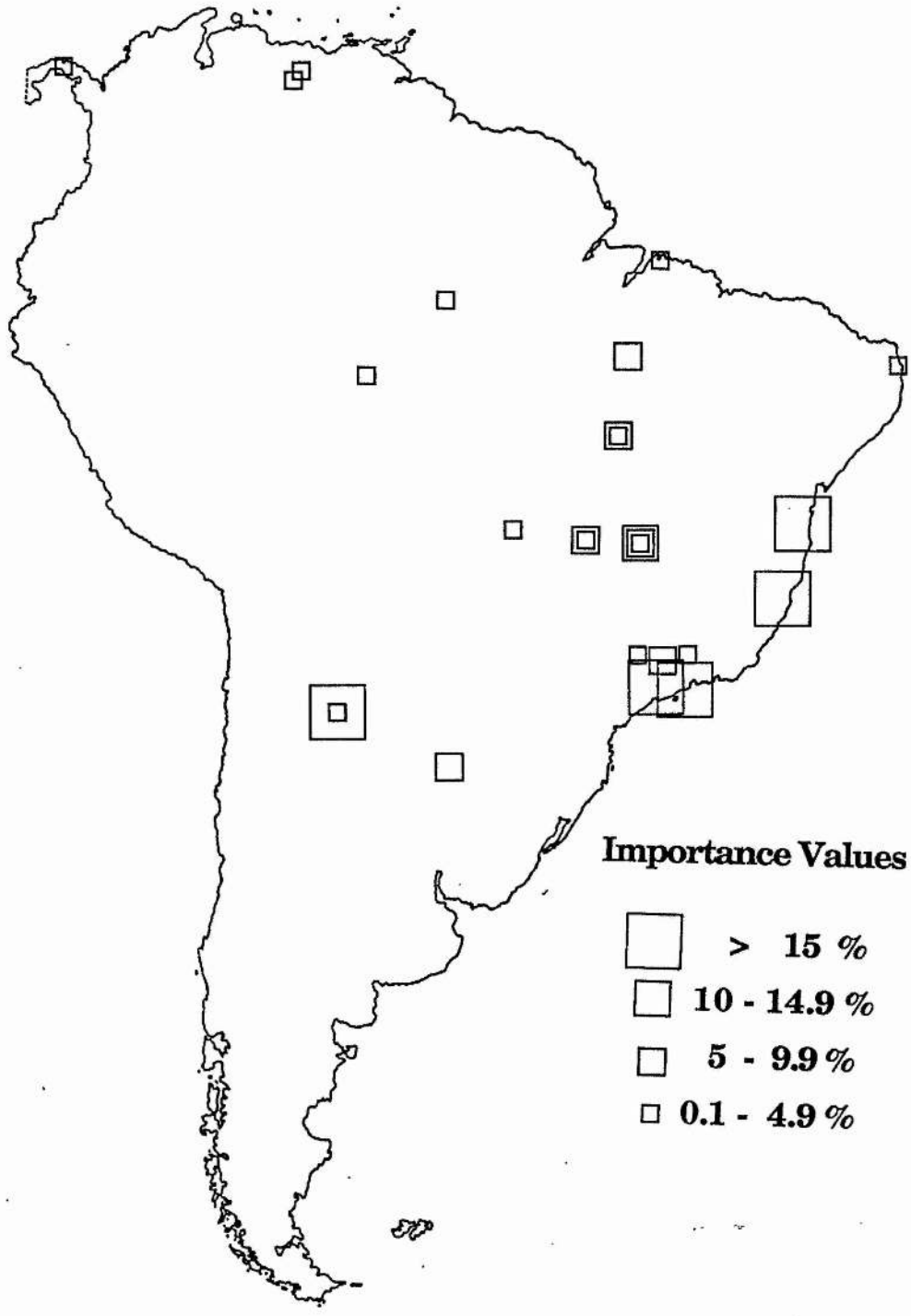


Fig. 3.4 - Diversity of Myrtaceae in various non-flooded South American communities

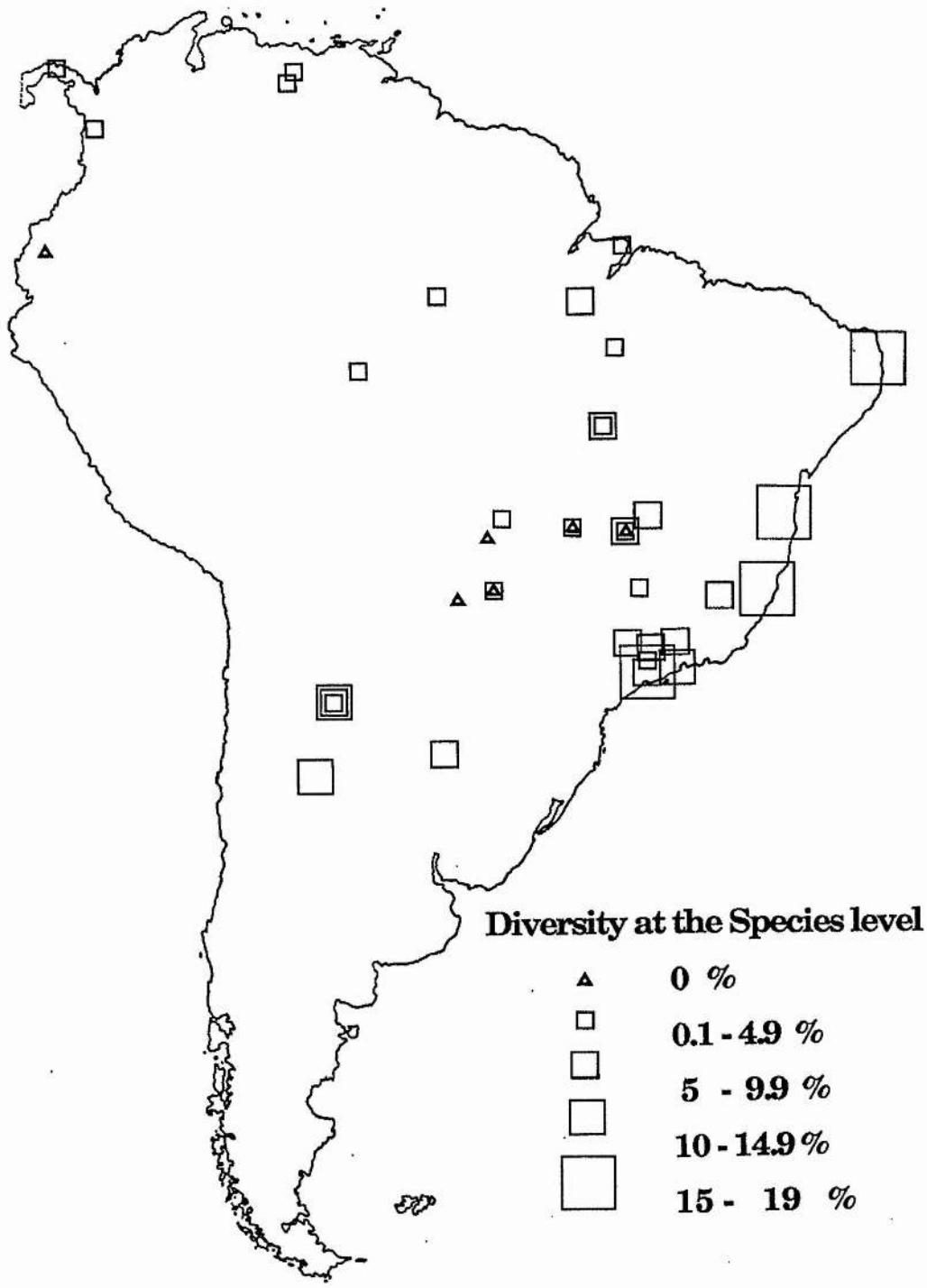


Table 3.1 - Flooded or very wet communities dominated by Myrtaceae

Locality	Kind of Vegetation	Reference
Indonesia	swampy variant of Dipterocarp forest *	Kartawinata 1980
Tasmania	cites of impeded drainage *	Kirkpatrick 1981
Chile	swampy forest 'bosque pantanoso' *	Ferriere 1981
Brazil	seasonally flooded forest 'cambarazal'**	Nascimento & Cunha 1989
Brazil	seasonally flooded forest 'mata de igapó'*	Keel & Prance 1979
Guyana	riverine vegetation *	Fanshawe 1954

* Subjective evaluation * Myrciaria dubia (Myrtaceae) ranked 1st ** Myrtaceae ranked 3rd

A South-American example of this is in the vicinity of Corumbá, Brazil, where Myrtaceae are either a minor component or absent from the tree and large shrub stratum of cerrado vegetation (Ratter & al. 1988 a), probably due to a combination of strong seasonality and richer soils. But in a temporarily flooded 'cambarazal' in the same general area, the family ranked 3rd in 'IVI' Importance Value (Nascimento & Cunha 1989). Unfortunately, no soil data is available for the 'cambarazal' but its description, 'laterite', suggests poor quality. Such an association with flooding probably has a physiological adaptive component to avoid anoxia. In flood-tolerant *Eucalyptus camaldulensis,* seedlings showed a flooding-induced response of increasing ethylene production. This resulted in root tissue hypertrophy and basal stem thickening which then acted to eliminate the ethylene build-up and enhance oxygen transport to the roots (Blake & Reid 1981). It is not known if other flood-tolerant Myrtaceae show the same response.

Even in non-flooded comunities, water availability still seems to be the key element. Seasonality of rainfall, especially if associated to a dry season with high temperatures that cause high evapotranspiration rates and water deficiency, tends to diminish the Myrtaceous element. Phytosociological and climatic data for non-flooded South-American communities (Table 3.2) revealed that in subtropical wet climate, (Köppen's [1946] Cf type) the family ranked between 1st - 3rd in importance while in the subtropical seasonal (Cw) it ranked between 1st - 28th. In the warmer tropical wet (Af) it ranked 1st - 8th while in the tropical seasonal (Aw) it ranked 1st - absent, and in transition between tropical seasonal and tropical monsoon (highly seasonal Aw/Am) the Myrtaceae ranked 6th -

absent.

Table 3.2 - Ecological importance of Myrtaceae in non-flooded South American communities

Locality	Vegetation	Assessment of Importance			Reference
		Parameter	Parameter %	Species %	
Brazil, São Paulo	montane forest	IVI	28.5	12.1	Rodrigues & al. 1989
Argentina, Salta	subtropical forest	IVI	26.6	14.7	Brown & al. 1985
Brazil, São Paulo	savanna woodland	IVI	19.4	19.0	Ratter & al. 1988 b
Brazil, Bahia	moist forest	IVI	19.0	15.0	Mori & al. 1983 a
Brazil, Espírito Santo	moist forest	DR	18.5	14.4	Peixoto & Gentry 1990
Brazil, São Paulo	savanna woodland	IVI	17.2	9.8	Ratter & al. 1988 a
Brazil, São Paulo	seasonal forest	IVI	16.9	14.3	Rodrigues & al. 1989
Brazil, Goiás	savanna woodland	IVI	12.3	2.6	Haridasan & Araújo 1988
Brazil, M. Grosso	savanna gradient	CVI	11.5	8.6	Oliveira Filho & al. 1989
Brazil, São Paulo	savanna woodland	IVI	9.0	7.4	Silberbauer-Gottsberger & Eiten 1987
Brazil, Pará	rainforest	FIV	8.25	6.0	Campbell & al. 1986
Argentina, Chaco	seasonal forest	IVI	7.4	5.7	Prado & al. 1989
Brazil, Tocantins	savanna woodland	IVI	6.8	6.9	Ratter 1987
Argentina, Salta	subtropical forest	PLT	?	10.3	Meyer 1963
Argentina, Salta	subtropical forest	IVI	4.9	6.8	Brown & al. 1985

Brazil, São Paulo	rain forest	IVI	4.3	13.0	Silva & Leitão Filho 1982
Brazil, Pará	rain forest	FIV	4.3	3.3	Salomão & al. 1988
Brazil, M. Grosso	gallery forest gradient	CVI	4.2	2.2	Oliveira Filho & al. 1990
Brazil, Paraíba	gallery forest	FR	3.7	12.5	Mayo & Fevereiro 1982
Brazil, Amazonas	rainforest	FR	3.0	3.0	Prance & al. 1976
Jamaica	montane forest	DoR	2.8	?	Tanner, 1977
Brazil, Tocantins	savanna woodland	IVI	2.4	5.1	Ratter 1987
Brazil, São Paulo	gallery forest	IVI	2.3	8.3	Gibbs & al. 1980
Venezuela	dry forest	CV	2.3	2.6	Gentry 1984
Brazil, Tocantins	dry forest-savanna woodland transit.	IVI	2.0	1.6	Ratter 1987
Brazil, R. Janeiro	coastal forest	IVI	1.9	3.5	Martinelli & al. 1990 (unpbl.)
Costa Rica, Guanacaste	gallery forest	CV	1.9	3.3	Gentry 1984
Brazil, Minas Gerais	regenerating 10 yrs. seasonal forest	IVI	1.5	1.8	Silva Jr. & al. 1988 (unpbl.)
Brazil, São Paulo	seasonal forest	IVI	1.4	5.0	Cavassan & al. 1984
Brazil, M.Grosso S.	savanna woodland	FR	1.0	2.6	Ratter & al. 1988 b
Colombia, Tutenendó	rainforest	CV	?	4.5	Gentry 1984
Panama Curundú	moist forest	CV	0.8	1.2	Gentry 1984
Argentina, Salta	subtropical forest	IVI	0.5	3.4	Brown & al. 1985
Ecuador, R. Palenque	moist forest	CV	0	0	Gentry 1984
Costa Rica, Guanacaste	dry upland forest	CV	0	0	Gentry 1984

M. Grosso	savanna woodland	IVI	0	0	Furley & al. 1988
Brazil, M. Grosso	seasonal forest	IVI	0	0	Furley & al. 1988
Brazil, M. Grosso	dry forest	IVI	0	0	Furley & al. 1988
Brazil, M. Grosso S.	savanna woodland	IVI	0	0	Ratter & al. 1988 b
Brazil, M. Grosso S.	deciduous forest	IVI	0	0	Ratter & al. 1988 b
Brazil, M. Grosso S.	savanna woodland	IVI	0	0	Ratter & al. 1988 b
Argentina, Chaco	dry forest	BB	0	0	Eskuche, 1986

IVI = DR + DoR + FR; FIV = DR + DoR + DiR; CV = DoR + DR

DoR = basal area/Σ b. a.; DR = trees/Σ trees; DiR = Species/Σ Species; FR = trees/area;

BB = Braun-Blanquet (1979).

Thus the Myrtaceae may rank first in any of these climatic types except Aw/Am but average importance for each type probably diminishes as they become drier and warmer.

A secondary factor affecting the success of the family within climatic types are soil properties. At least one species of *Eucalyptus* is capable of using insoluble phosphorous (Mullette 1974) and many Australian Myrtaceae also have ectomycorhiza which help them to cope with dystrophic soils, especially during the dry season (Bowen 1981). Both capacities would be extremely useful in the poor cerrado soils (notably low in phosphorous) but I am unaware of studies on neotropical species of Myrtaceae with regards to these effects.

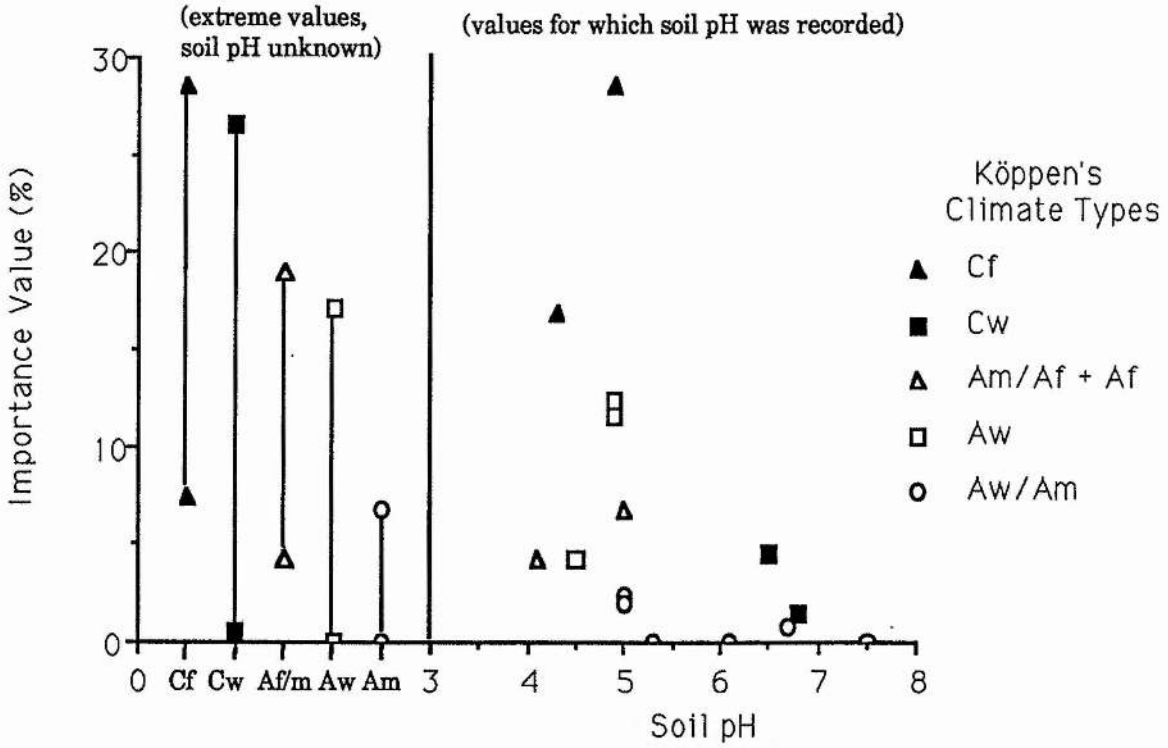
An unidentified species of *Eugenia* from Padre Bernardo, c. 150 km North of Brasília, accumulates aluminium in the leaves (Haridasan & Araújo 1988). This a relatively uncommon ability which is most noteworthy for its ubiquity in cerrado taxa of the Vochysiaceae, which are obligate accumulators. Other families with aluminium accumulating species in cerrado are Rubiaceae and Melastomataceae (Haridasan 1982).

Acidity seems to be one of the most important soil properties and most high Importance Values occurred on acidic soils with pHs between 4 and 5 (Fig. 3.2).

The importance value of *Eugenia virgultosa,* a minor component of three out of a series of four montane forests in Jamaica (Tanner 1977), varied with soil

pH as can be seen in Fig. 3.5. In an area in South-eastern Brazil, *Siphoneugena densiflora* was the highest ranking species in three out of a series of six altitudinal plots (Rodrigues *et al.* 1989). Figure 3.2 shows how its importance varied with soil pH. In this latter series, Myrtaceae as a family ranked first in all six plots but the actual importance value of the family was highest in the plot where *Siphoneugena densiflora* ranked lowest. In this plot, *Siphoneugena densiflora* was substituted as most important species by another Myrtaceae, *Calycorectes sellowianus.*

Fig. 3.2 - Effects of soil pH on importance values of Myrtaceae in different climates



Because an abrupt increase in altitude tends to bring about both lower temperatures and increased rainfall there may be a dramatic rise to dominance of Myrtaceae above certain altitudinal levels. This is what Meyer (1963) and Brown et al. (1985) call the 'selva de Mirtáceas' at the foot of the Andes in NW Argentina. The same effect occurs in the Serra do Japi Mountain Range in SE Brazil (Rodrigues *et al.* 1989). In these two areas the Myrtaceae attained its

highest values of importance (Table 3.2 and Fig 3.2), far above those registered

Fig. 3.5 - Variation of relative dominance with soil pH of *Eugenia virgultosa*

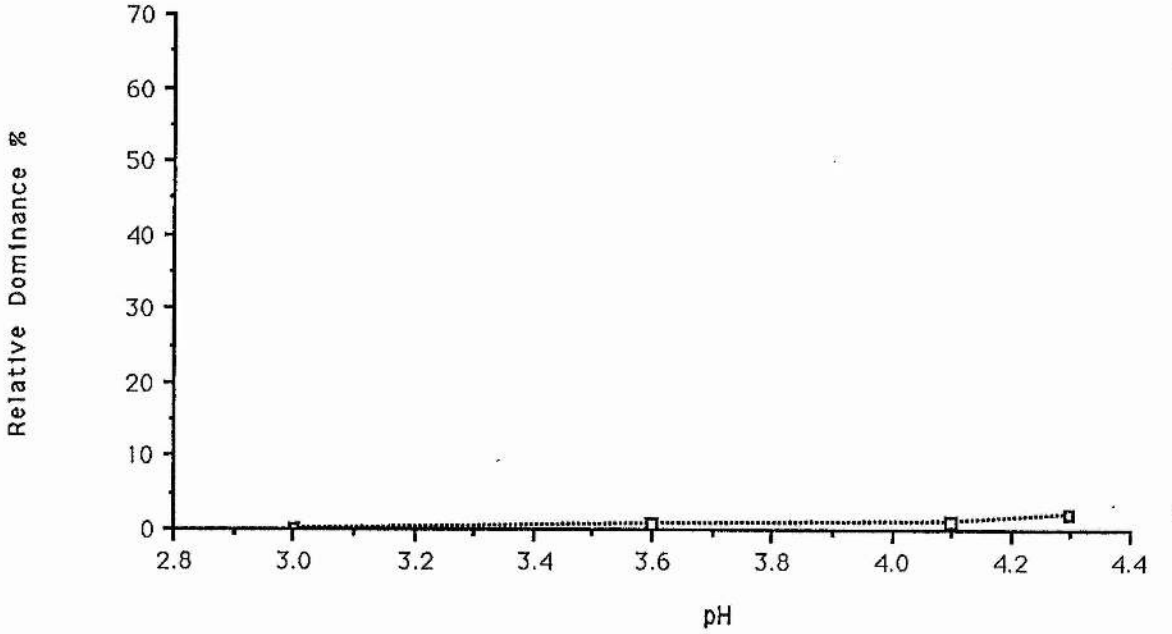
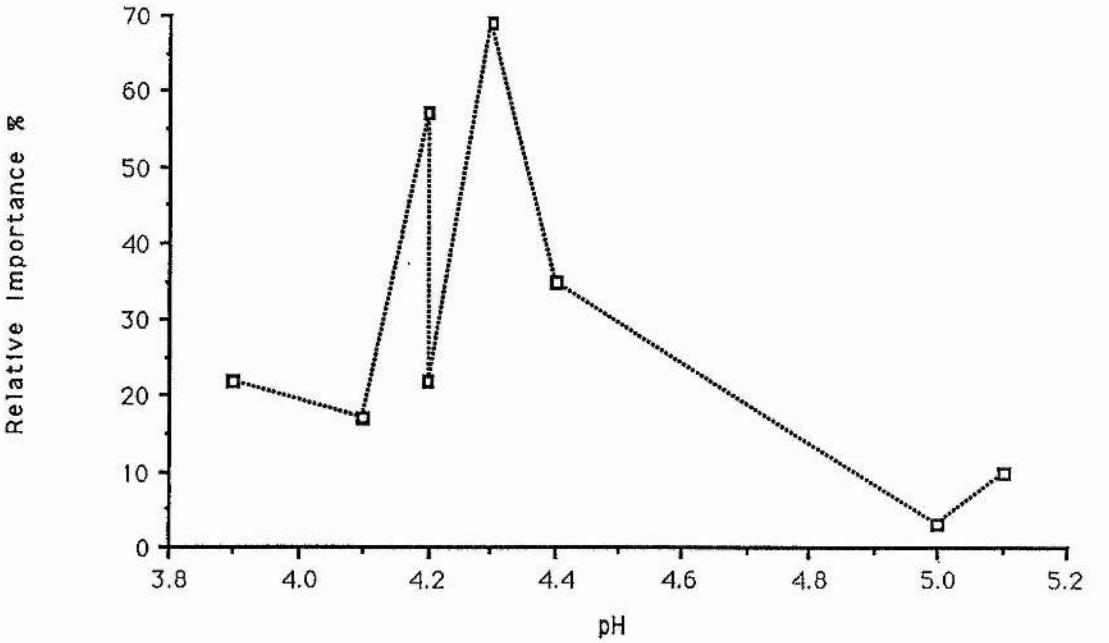


Fig. 3.6 - Variation of importance value with soil pH of *Siphoneugena densiflora*



anywhere else, monopolizing roughly a quarter of the plant biomass in these forests!

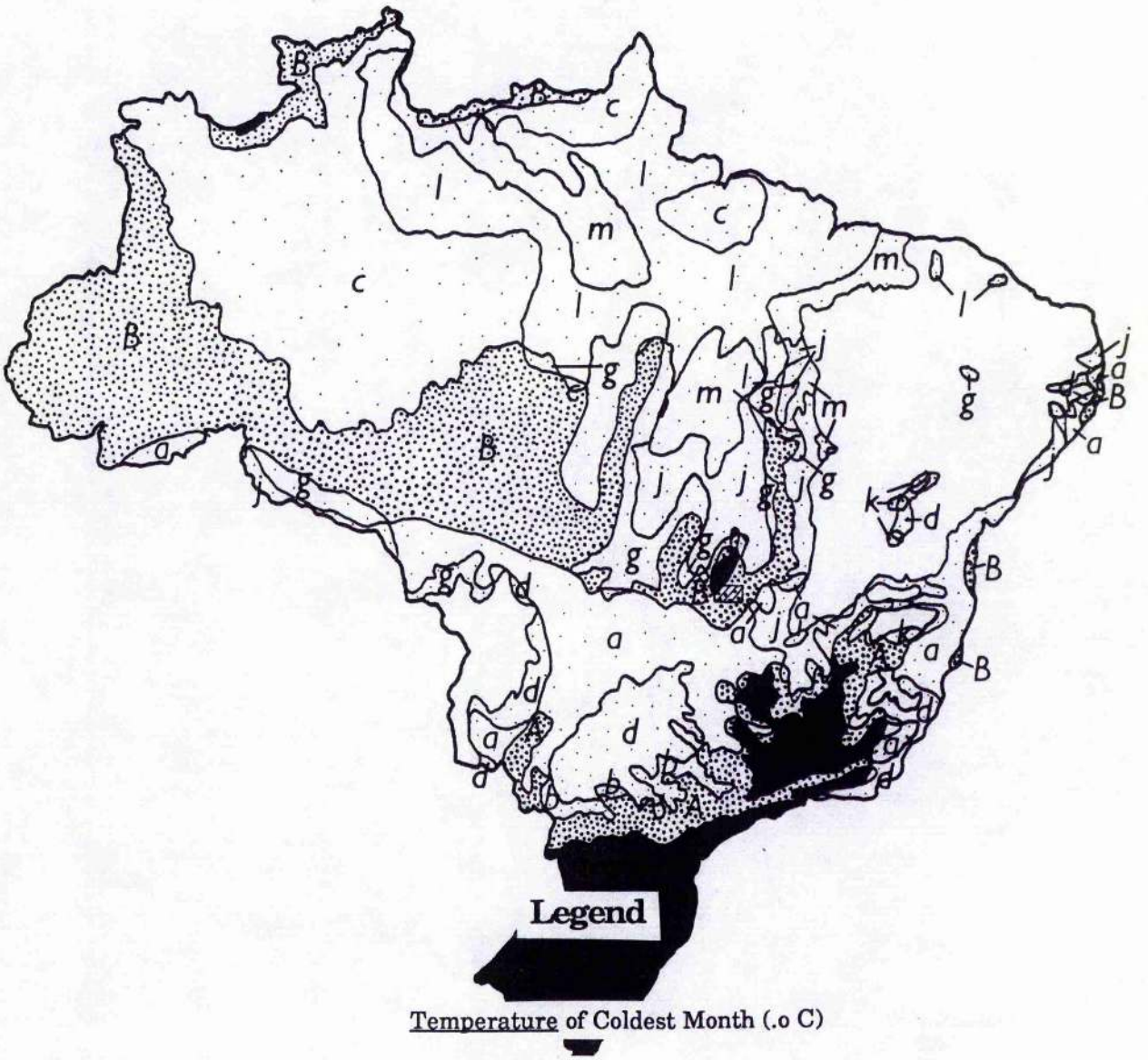
In addition to optimum environmental conditions, there are bio-historical reasons for the extraordinary success of the family in these areas. Both are to the north of Landrum's proposed temperate, early Tertiary forest. They may in fact be considered 'altitudinal relicts' of this forest, in the sense that a large proportion of their elements probably originated there, migrated northwards during cooler periods and then became established on mountain ranges where they survived the timberline shifts caused by Pleistocene glaciations by moving up and down the mountains.

Based on information in phytosociological analyses in Table 3.2, distributions of recently monographed genera (Landrum 1981, 1986, Proença 1990) and herbarium specimen labels for other genera, I have compiled a distribution map for the family in Brazil. I then analyzed various combinations of isotherms and isohyets (fide Camargo & *al.* 1976) to elaborate a climatic map which would underpin this distribution (Fig. 3.7).

The black areas in Figure 3.7 are those considered optimal for Myrtaceae. Nineteen of the twenty genera found in Brazil occur within the boundaries of the core area, with the following six genera restricted to it: *Acca, Accara, Myrrhinium, Myrceugenia, Neomitranthes* and *Pimenta*. Of these, *Acca* is restricted by the colder isohyets with mean temperatures of the coolest month below 14 ^{o} C, while the distributions of *Myrrhinium, Neomitranthes* and *Myrceugenia* closely follow the boundaries, this latter genus also occurring in an island outpost in the Distrito Federal (Landrum 1981) and in marginally favourable conditions in the Pico das Almas region in Bahia. Several of the other genera that also occur outside of the optimal region have most of their species there, such as *Campomanesia, Siphoneugena,* and possibly *Calycorectes.* The only genus that does not occur here is Amazonian *Calycolpus.*

The favourable and marginally favourable (respectively large and small dotted areas in Figure 3.7) support representatives of the larger genera, such as *Myrcia, Eugenia* and *Psidium,* allied to a few of the hardier species of the more specialized genera, e. g. *Blepharocalyx salicifolius.* Both upper case and lower case letters assigned to each dotted area indicate the specific climatic conditions, as can be interpreted by refering to the legend. Roughly speaking, diversity and

Fig. 3.7 - Climatic zones for Myrtaceae in Brazil



ecological importance of Myrtaceae tend to decrease in alphabetical order as conditions become further and further away from the optimum. The map is on quite a large scale and each species will naturally have its own level of tolerance to climatic conditions, so local deviance from the expected distribution may occur.

The Distrito Federal is mostly within favourable type B area (temperatures slightly higher than optimum, total water availability optimum but seasonal) with 12 genera and 65 species. An attempt was made to map the Distrito Federal Myrtiinae and Eugeniinae throughout their ranges of distributions. Many important regions in Brazil are still undercollected, so the following paragraphs should be viewed as a very preliminary survey.

A) There was no difference in patterns of distribution between subtribes or genera, but rather each type of distribution pattern usually had equivalent numbers of species of different genera.

B) There was little difference in gross patterns of distribution between cerrado and gallery forest species. This may be because, besides being a limit of Cw temperatures, the Distrito Federal also represents the northernmost limits of the Plate River Basin. *Eugenia uruguayensis,* a rare species in the Distrito Federal, which is strongly associated to the rivers of the Plate basin, for example, has only been collected on afluents of that river Basin.

D) A remarkably large number of species had their northernmost points of distribution in or close to the Distrito Federal. Although this is probably partially an artefact of concentrated collecting effort since Brasília was built, it is such a strong trend that it must also reflect a biogeographical reality. This suggests that although the cerrado Biome extends considerably north, even the typical cerrado Myrtaceae, such as *E. dysenterica* are in general limited to the southern part of it, although a few species seem to be specialized in the northern part and do not occur in the southerly cerrados region.

The following patterns of distribution were observed (the terms southerly and northerly take the Distrito Federal as point of referrence) which are presented below in order of importance, as assessed by number of taxa:

1) Southerly Distribution - This is by far the commonest pattern of distribution, going in its maximum span from c. 30 ^{o} S to c. 12 ^{o} S (a few degrees North of the Distrito Federal) through Uruguay, Paraguay, Argentina and South, South-eastern and Central Brazil. It is that presented by the following

species: *Blepharocalyx salicifolius* (Fig. 3.26), *Campomanesia adamantium* (Fig. 3.27), *C. pubescens* (Fig. 3.30), *C. sessiliflora* var. *lanuginosa* (Fig. 3.31), *C. velutina* (Fig. 3.32), *Eugenia angustissima* (Fig. 3.8), *E. bimarginata* (Fig. 3.9), *E. bracteata* (Fig. 3.10), *E. cristaensis* (Fig. 3.12), *E. dysenterica* (Fig. 3.13), *E. klotzschiana* (Fig. 3.16), *E. lutescens* (Fig. 3.17), *E. myrcianthes* var. *nana* (Fig. 3.18), *E. piloesis* (Fig. 3.20), *E. uruguayensis* (Fig. 3.22), *Myrciaria glanduliflora* (Fig. 3.22), *Siphoneugena densiflora* (Fig. 3.24), *Pimenta pseudocaryophyllus* (Fig. 3.33), *Psidium aerugineum* (Fig. 3.34), *P. australe* (Fig. 3.35), *P. bergianum* (Fig. 3.36), *P. cinereum* var. *paraguariae* + var. *incanescens* (Fig. 3.37), *P. firmum* (Fig. 3.38), *P. longipetiolatum* (Fig. 3.40), *P. luridum* (Fig. 3.41), *P. pohlianum* (Fig. 3.43), *P. pubifolium* (Fig. 3.44) and *P. rufum var. widgrenianum* (Fig. 3.45). In the more specialized cerrado species, this is contracted at the Southern half to around 23 º S, which is the latitude that this kind of vegetation begins to appear, whilst gallery forest, campo species or facultative species (such as *E. bracteata*) may range more to the South into the forested and rocky campos regions, although some (such as *P. rufum var. widgrenianum*) do not. It is possible that there is a subtype of this kind of distribution, ranging from the highlands of Minas Gerais inland into the richer soils of the Mato Grosso highlands and sometimes on the North-eastern cerrado outcrops, such as the Serra das Almas and Serra da Jacobina in Bahia or the Chapada do Araripe in Ceará, but collections of the species involved are too few to be certain of this. Species which might present this pattern are *Eugenia cristaensis E. piloesis, Myrciaria glanduliflora, Psidium bergianum, P. firmum, P. pohlianum* and *P. pubifolium.*

2) Wide-ranging distribution - This pattern of distribution is roughly from the same southern latitude as above (30 º S), but ranging much to the north (near the equator or into the northern hemisphere) and also wider than above from Brazil into Bolivia and Peru. It is presented by *Eugenia punicifolia* (Fig. 3.21), *Psidium guineense* (Fig. 3.39), and *Myrciaria tenella* (Fig. 3.24), dry forest species except for *E. punicifolia,* which also grows in savannas *sensu latissimo,* and by *Eugenia florida* (Fig. 3.14), a riverine, wet or dry forest species.

3) Northerly cerrados distribution - This pattern is presented by three taxa which range from the Distrito Federal (c. 15 º) to c. 10 º S, in the Northerly part of the Cerrados region. These are *Eugenia piauhiensis* (Fig. 3.19), *Psidium myrsinoides* (Fig. 3.42) and *Campomanesia eugenioides* var. *desertorum* (Fig. 3.29).

4) Forests up into Northern South America - Two species that have this

pattern of distribution are *Psidium sartorianum* (Fig. 3.46) and *Campomanesia aromatica* (Fig. 3.28): this latter species may be synonymous to *C. xanthocarpa,* however, in which case the distribution would be as in 2.

5) Endemic - *Eugenia complicata* (Fig. 3.11) seems to be restricted to a small region in the core area of the cerrados region surrounding the Distrito Federal, where it has been extensively collected.

One marginally favourable area (characterized by small dots and letters in lower case in Figure 3.7) in the Pico das Almas region in Central Bahia (b, d & k type) has also been recently studied floristically (Lughadha 1991, unpubl.) and was found to have nine genera which comprise those that occur in the Distrito Federal minus *Myrciaria, Pimenta* and *Siphoneugena* and 30 species, roughly half the number of species in the Distrito Federal. It is notable in this context that the Pico das Almas region is surrounded by an inhospitable climatic area and probably represents a Pleistocenic relict, while the island of optimum climate just North of the Distrito Federal is connected by a region of marginally favourable climate to the core optimal climatic area.

In Figure 3.7 the white areas represent those which appear to be the least suitable for Myrtaceae (occupied by Caatinga and Pantanal vegetation) and the species that do grow within its boundaries are probably the most tolerant of the larger genera and only occur in gallery forests or highland 'chapadas' where passably favourable microclimatic conditions may occur. With the exception of one species, *Campomanesia eugenioides* (var. *desertorum*), none of the recently monographed genera cited above occurred within the white areas. Another factor is that the soil of the white areas is usually richer than those of the black and dotted areas, which is an additional limitation to Myrtaceae. *Campomanesia eugenioides* is a calciphilous species (Oliveira Filho & Martins 1986; personal observation) and thus edaphically adapted to invade the caatingas. A regional study within the caatingas region, of the Serra da Capivara in South-eastern Piauí (Emperaire 1984), cites only four Myrtaceae only among 348 species of Dicotyledons: one *Eugenia,* one *Psidium,* and two species cited only by common names. One of these 'gabiroba' is probably *Campomanesia eugenioides* , the other 'catuaba branca' may not be a species of Myrtaceae. The name 'catuaba' is much used for species of *Erythroxylon* and it is also my experience that it is common for species of that genus to be misidentified as Myrtaceae. Thus this area may have only three genera, with both the species of *Eugenia* and the putative *Campomanesia eugenioides* being cited as growing on 'chapadas'.

The island of optimal climate just North of the Distrito Federal is probably one of the factors to explain the large number of genera and species and ecological success of the family within the Distrito Federal (see Table 1. 3), as well as lower values found in surrounding warmer regions (e. g., in the 'Triângulo Mineiro', Goodland & Ferri 1979). It may also explain why so many species appear to have their northern limits in the Distrito Federal or thereabouts.

Another favourable factor in the Distrito Federal is the poor quality of soil, which is amongst the poorest of the cerrados region (Haridasan 1984). Finally, its geographic location, not too far North from the optimum region, exposed to both easterly and westerly influences and connected to the main forested regions of Brazil by its rivers and associated gallery forests, has probably also played a part in maintaining the richness of the myrtaceous flora.

3.8 - Distribution of *Eugenia angustissima*

3.9 - Distribution of *Eugenia bimarginata*

3.10 - Distribution of *Eugenia bracteata*

3.11 - Distribution of *Eugenia complicata*

3.12 - Distribution of *Eugenia cristaensis*

3.13 - Distribution of *Eugenia dysenterica*

3.14 - Distribution of *Eugenia florida*

3.15 - Distribution of *Eugenia glandulosa*

3.16 - Distribution of *Eugenia klotzschiana*

3.17 - Distribution of *Eugenia lutescens*

3.18 - Distribution of *Eugenia myrcianthes* var. *nana*

3.19 - Distribution of *Eugenia piauhiensis*

3.20 - Distribution of *Eugenia piloesis*

3.21 - Distribution of *Eugenia punicifolia*

3.22 - Distribution of *Eugenia uruguayensis*

3.23 - Distribution of *Myrciaria glanduliflora*

3.24- Distribution of *Myrciaria tenella*

3.25 - Distribution of *Siphoneugena densiflora*

3.26 - Distribution of *Blepharocalyx salicifolius*

3.27 - Distribution of *Campomanesia adamantium*

3.28 - Distribution of *Campomanesia aromatica*

3.29 - Distribution of *Campomanesia eugenioides*

3.30 - Distribution of *Campomanesia pubescens*

3.31 - Distribution of *Campomanesia sessiliflora* var. *lanuginosa*

3.32 - Distribution of *Campomanesia velutina*

3.33 - Distribution of *Pimenta pseudocaryophyllus* var. *fulvescens*

3.34 - Distribution of *Psidium aerugineum*

3.35 - Distribution of *Psidium australe*

3.36 - Distribution of *Psidium bergianum*

3.37 - Distribution of *Psidium cinereum*

3.38 - Distribution of *Psidium firmum* .

3.38 - Distribution of *Psidium guineense*

3.40 - Distribution of *Psidium longipetiolatum*

3.41 - Distribution of *Psidium luridum*

3.42 - Distribution of *Psidium myrsinoides*

3.43 - Distribution of *Psidium pohlianum*

3.4 - Distribution of *Psidium pubifolium*

3.4 5 - Distribution of *Psidium rufum* var. *widgrenianum*

3.46 · Distribution of *Psidium sartorianum*

CHAPTER 4 - TAXONOMY OF SUBTRIBES EUGENIINAE AND MYRTIINAE

Methods

Most of the exsciccatae came from the Distrito Federal Herbaria, UB, IBGE and HEPH or from E, F and K, which were visited and scanned; the following Herbaria also loaned material, notably types: BR, G, M, S, U, UEC, US. In total, c. 800 numbers of Distrito Federal Myrtaceae were examined and c. 500 extra-Distrito Federal material of the same species were also examined, so descriptions apply to the species throughout its range. I am aquainted with almost all the cerrado species in the field but with very few of the gallery forest species. Three flowers of each species or more were dissected, from Distrito Federal material if available. Drawings were made with a Camera Lucida attached to a Wild M-5 dissecting microscope. Data was stored and manipulated using the Hypertaxonomy software designed by danish botanist Dr. Flemming Skov for revisional work (see Skov 1989); this runs on the Hypercard application of the Apple MacIntosh.

Types of all names encountered on determination slips or that were cited in *Flora Brasiliensis* (Berg 1857, 1859) as collected in Goiás were requested on loan, as well as several others due to similarity of the descriptions. Nevertheless, many types were not examined, notably those in Paris. I have included any tentative new synonyms involving such material, of which I have not seen the types, with a question mark before the name. If the species was considered synonymous by some former author, it will appear without a question mark and without the syn. nov. assignation. Distribution maps for the species are at the end of Chapter 3, in alphabetical order within the subtribes.

Characters

Characters studied and used in descriptions were mostly those traditional in the Myrtaceae. I have included, however, a few others that I believe have been underestimated.

1) Exact number of stamens, ovules and ovules per locule: this is a time-consuming character, especially in the Myrtiinae, but probably worth the effort. Traditionally cited only as 'biovulate', 'pauciovulate' (for locules with c.

3-12 ovules) and 'multiovulate' (for locules with more than c. 12 ovules), the exact number of ovules, either per locule and per ovary, can sometimes be quite stable in some species, e. g. *Eugenia florida, Eugenia dysenterica.*

2) Position of stamens and style in bud: this seems to be quite a consistent character, at the generic level in *Psidium* and *Siphoneugena,* at the specific level in *Eugenia.*

3) Colour of the fruit and of the fresh embryo is almost certainly a very useful character in the Myrtaceae, but is one which unfortunately requires a great deal of field knowledge. I have included this where I had seen fruits in the field. Of the species that I have seen, the embryos of *Psidium* are always cream-coloured when fresh, and those of *Blepharocalyx, Campomanesia, Gomidesia* and *Siphoneugena* bright green. In *Eugenia,* species of the *Phyllocalyx - Stenocalyx* alliance seem to have large cream embryos while in other groups it is small and bright green.

4) Sculpturing of the seed testa: this character has recently been used successfully in delimiting genera in the Myrtiinae (Landrum & Sharp 1989). I have found it also to be useful in the Eugeniinae at the specific level in *Eugenia;* the seed coat of *Siphoneugena densiflora* seems to be distinct from those of *Eugenia,* but a larger sample is required to assess the usefulness of this character at the generic level.

Taxonomic Treatment

MYRTACEAE L. *Species Plantarum,* ed. 1 (1): 470. 1753.

Trees, shrubs or perennial subshrubs woody at base or underground. Leaves opposite or sometimes subopposite; stipules absent; blades frequently with translucid oil glands; venation brochidodromous frequently forming a conspicuous submarginal vein. Inflorescence paniculate, racemose, regularly dichotomous, dichasial or uniflorous,usually bracteate at least when young. Buds open or completely closed at apex, bracteolate at least when young. Anthesis occurs as the calyx lobes open in the open buds and by a calyptra or by longitudinal rupture of the hypanthium in the closed buds. Hypanthium ending with the calyx lobes at the level of the insertion of the style or somewhat prolonged, forming a tube which raises the staminal disk, corolla and calyx lobes above the level of insertion of the style. Calyx lobes, when present, 4-5. Petals white or pale pink, free, imbricate in bud, 4-5. Stamens free, ±8-500. Ovary inferior, immersed in the hypanthium; locules 2-many; ovules 1-many per

locule; placentation axilar; style 1, filiform; stigma 1, truncate to peltate. Fruit fleshy. Seeds 1-many; testa membranaceous to woody. Embryo undivided or with distinct hypocotyl and cotyledons; hypocotyl minute or massive, frequently coiled around the cotyledons; cotyledons either fleshy and plano-convex like in a bean, leaflike and tightly crumpled or else minute at the end of the massive hypocotyl.

Key to the genera of Myrtaceae that occur in the Distrito Federal

1a Buds with 4 well-defined calyx lobes; ovary 2-3 locular.....2
1b Buds with 5 well-defined calyx lobes, rarely calyptrate or the nearly or completely closed flower bud tearing into 2-5 lobes; ovary 2-18 locular.....6

2a Hypanthium prolonged into a cup which raises the staminal disk and calyx lobes above the level of insertion of the style, this hypanthial cup caducous after fertilization leaving a ring-like scar on the ovary; fruit round, black when mature, crowned by this scar.....3
2b Hypanthium not prolonged into a cup, the staminal disk flush with the style base or nearly so; fruit of various shapes and sizes, crowned by the persistent calyx lobes or by the squarish or circular persistent hypanthial cup, the individuals lobes sometimes caducous.....4

3a Flowers pedicellate (rarely the apical one sessile) in normal or umbel-like racemes; ovary locules 2-3; ovules 3-7 per loculus, never consistently 2 or 4 per loculus; fruit pedicellate.....**3. *Siphoneugena*** (Subtribe Eugeniinae)
3b Flowers sessile or nearly so; ovary locules 2; ovules consistently 2 or 4 per loculus; fruit sessile or nearly so.....**2. *Myrciaria*** (Subtribe Eugeniinae)

4a Inflorescence a series of 1-4 superimposed, supra-axillary, pedicellate flowers which lack bracts at the base of the pedicels; embryo with a terete, elongate hypocotyl coiled around the leaflike, tightly crumpled cotyledons.....***Myrceugenia*** (Subtribe Myrciinae)
4b Inflorescence solitary flowers or raceme, sometimes a contracted umbel-like raceme with 1-4 pedicellate flowers but then bracts clustered at the base of the pedicels; embryo undivided, with a false dividing line or with 2 free, plano-convex cotyledons and a minute hypocotyl, like a pea.....**1. *Eugenia*** (Subtribe Eugeniinae)
4c Inflorescence a 3-31-flowered cyme with sessile flowers in the forks; embryo a swollen c-shaped or uncinate hypocotyl with 2 minute cotyledons at base.....5

5a Fruit crowned by the squarish hypanthial cup remnant, the individual lobes caducous.....**1. *Blepharocalyx*** (Subtribe Myrtiinae)
5b Fruit crowned by the slightly incurved calyx lobes.....**3. *Pimenta*** (Subtribe Myrtiinae)

6a Ericoid shrubs with solitary flowers or few-flowered, reduced panicles; calyx lobes 5; ovary 2-3 locular, the locules consistently 2-ovulate.....***Myrcia*** (Subtribe Myrciinae)
6b Without the above suite of characters.....7

7a Inflorescence a solitary flower, 3-flowered dichasium or precocious raceme; locules of the ovary (2-)3-10; ovules 4-11; fruit green, yellow or pale orange when mature, with several to many seeds, virtually never 1-seeded; testa hard and dull or thin and verrucose (pseudo-testa).....8
7b Inflorescence a panicle; locules of the ovary 2-3; ovules consistently 2; fruit usually black when mature, 1(-3) seeded; testa thin and shiny.....9

8a Flowers solitary; calyx lobes well developed, flaring, not tearing between the lobes at anthesis; seeds rather flat with a membranaceous, verrucose pseudotesta.....**2. *Campomanesia*** (Subtribe Myrtiinae)
8b Flowers solitary, in dichasia or precocious racemes; calyx lobes, if present (sometimes calyptra), frequently tearing slightly to deeply between the lobes; seed not flat with a bony, dull testa.....**4. *Psidium*** (Subtribe Myrtiinae)

9a Inflorescence with deep rusty-reddish pubescence; flower buds closed, opening by a calyptra.....***Calyptranthes*** (Subtribe Myrciinae)
9b Inflorescence glabrous or with various degrees of pubescence; flower buds with 5 calyx lobes.....10

10a Hypanthium prolonged into a cup which raises the staminal disk and calyx lobes above the level of insertion of the style; calyx lobes minute in bud (below 0.5 mm), partially detaching at base at anthesis and sometimes completely so in the fruit.....***Marlierea*** (Subtribe Myrciinae)
10b Hypanthium prolonged or not prolonged into a cup; calyx lobes large to minute, not partially detaching at anthesis (sometimes spliting at the sinuses), the fruit thus crowned by all five lobes, sometimes allied to a prolonged hypanthial cup.....11

11a Anther thecae with the locules staggered, the upper ones slightly extrorse, the lower ones introrse; young fruits and fruiting calyx lobes with strigulose, brownish hairs, the individual fruiting calyx lobes barely discernible, forming a small stiff crown.....***Gomidesia*** (Subtribe Myrciinae)
11b Anther thecae with the locules of equal length and perfectly parallel; young fruits round to elongated, glabrous or pubescent, the individual calyx lobes usually somewhat diverging or reflexed.....***Myrcia*** (Subtribe Myrciinae)

Subtribe Eugeniinae

Inflorescence solitary, axillary flowers or normal raceme, precocious raceme (a raceme which continues vegetative growth after the buds are produced) or highly contracted modified axillary raceme; calyx lobes 4; locules of the ovary 2. Seeds 1(-4), embryo undivided, presenting a false (incomplete) inter-cotyledonary dividing line or the cotyledons free with a minute hypocotyl similar to that of a papilionoid legume.

Fig. 4.1-Several flowering specimens of Myrtaceae of the Distrito Federal: a) *Eugenia bracteata* b) *Eugenia lutescens* c) *Eugenia klotzschiana* d) *Eugenia dysenterica* e) *Psidium incanescens* var. *paraguariae* f) *Blepharocalyx salicifolius.*

Figure 4.1 - Flowering material of the Myrtaceae of the Distrito Federal

Fig. 4.2-Several fruiting specimens of Myrtaceae of the Distrito Federal: a) *Eugenia angustissima* b) *Eugenia bracteata* c) *Psidium firmum* d) *Eugenia lutescens* e) *Siphoneugena densiflora* f) *Eugenia punicifolia* g) *Eugenia glandulosa* h) *Campomanesia velutina*

Figure 4.2 - Fruiting material of the Myrtaceae of the Distrito Federal

1. *Eugenia* L. *Species Plantarum,* ed. 1 (1): 470. 1753. Based on *Eugenia uniflora* L.

Syn.: *Catinga* Aubl. *Plantes de la Guyane Française* 1: 511. 1775. Type. *C. moschata* Aubl. = ? *E. feijoi* Berg.

Greggia Gaertn. *De fructibus et seminibus plantarum* 1: 168. 1788. Type. *G. aromatica* Gaertn. = *E. greggi* (Sw.) Poir.

Olynthia Lindl. *Collectanea botanica* 3: Tab. 19. 1821. Type?

Jossinia Comm. ex DC. *Prodromus* 3: 237 (1828). Type?

Opanea Raf. *Sylva Telluriana* 106 (1838). Type?

Epleienda Raf. *Sylva Telluriana* 107. 1838. Type. *Epleienda micrantha* (H.B.K.) Raf. = *Eugenia micrantha* H. B. K.

Suarda Nocca ex Steudl. *Nomenclator botanicus* 2: 651. 1841. Type?

Cerocarpus Hassk. *Flora* 25(2): 36. 1842. Type?

Syllysium Meyen & Schau. *Nov. Acta Acad. Nat. Cur.* 19 (Supl. 1): 334. 1843. Type?

Hexachlamys Berg *Linnaea* 27: 345 (1855). Type. *Hexachlamys humilis* Berg = *Eugenia myrcianthes* Nied.

Stenocalyx Berg *Linnaea* 27: 309 (1855). Type. *S. uniflorus* (L.) Berg = *E. uniflora* L.

Phyllocalyx Berg *Linnaea* 27: 306 (1855). Type. *P. involucratus* Berg = *E. bracteata* Vell.

Myrciaria sect. *Dichotomae* Berg *Fl. Bras.* 14(1): 359. 1857. Type. *Myrciaria deserti* (Camb.) Berg = *Eugenia deserti* Camb.

Myrciaria sect. *Paniculatae* Berg *Fl. Bras.* 14(1): 360. 1857. Lectotype hereby proposed. *Myrciaria micrantha* Berg.

Psidiastrum Bello *Anal. Soc. Española Hist. Nat.* 10: 272. 1881. Type. *P. dubium* Bello = *E. axillaris* (Sw.) Willd.

Myrtopsis O. Hoffm. *Linnaea* 43: 133. 1881. Type?

Pseudoeugenia Scortech. *J. Bot.* 23: 153. 1885. Type?

Chloromyrtus Pierre *Bull. Soc. Linn. Paris (N. Ser.)* : 71. 1898. Type?

Myrcialeucus Rojas *Bull. Geog. Bot.* 23: 217. 1914. Type. *M. odorifolius* Rojas

Pseudeugenia Legr. & Mattos *Arq. Bot. do Estado de S. Paulo* 4(2): 63. 1966. **nov. syn.** *Pseudeugenia stolonifera* Legr. & Mattos = *Eugenia stolonifera* (Legr. & Mattos) Proença, **nov. comb.**

Trees, shrubs or perennial subshrubs woody at base or underground.

Inflorescence a normal or highly modified axillary raceme in which the rachis is so contracted that it resembles an umbel (umbel-like raceme) or else continues vegetative growth and produces leaves under each bud so that it seems like a branch with a series of solitary, axillary flowers in later stages (precocious raceme). Bracts and bracteoles free, usually persistent in fruit. Buds open at the apex with anthesis ocurring by unfurling of the calyx lobes. Hypanthium ending with the calyx lobes at the same level as the insertion of the style or rarely very slightly prolonged. Calyx lobes 4, usually with a smaller outer pair and a larger inner pair. Petals white or pale pink, glabrous. Anthers roundish or oblong; locules opening by straight, longitudinal slits which are parallel to the filaments. Ovary bilocular; ovules 2-30 per locule; stigma truncate. Berry black, red, orange or yellow, globose, elliptic or pyriform, with persistent green or dry calyx lobes; pericarp very thick or thin. Seeds 1(-3); testa membranaceous. Embryo undivided, presenting a false (incomplete) inter-cotyledonary dividing line or the cotyledons completely free with a minute hypocotyl like a pea.

A large genus estimated to have c. 500 Neotropical species distributed from Mexico, Florida and the West Indies to North-Western Argentina (McVaugh 1968). It is represented in the Distrito Federal by 15 species, but the occurrence of an additional two is likely, so these are included in the flowering key.

The Distrito Federal *Eugenia* can be divided into five alliances: 1) the *Phyllocalyx* alliance is composed of *E. bracteata, E. dysenterica* and *E. glandulosa,* species which were previously segregated by Berg in genera *Phyllocalyx* and *Stenocalyx,* and characterized by precocious racemes, rather large flowers and calyx lobes and yellow or red fruits with cream false plano-convex embryos; 2) the *E. pyriformis* alliance composed of *E. lutescens, E. myrcianthes* and perhaps *E. pyriformis,* characterized by solitary flowers or dichasia, pubescent flowers (including the inner walls of the ovary) and yellow, pubescent fruit with large, cream false plano-convex embryos; 3) the *E. pluriflora* complex composed of *E. bimarginata, E. piloesis, E. piauhiensis, E. punicifolia* and *E. uruguayensis,* characterized by umbel-like racemes, small flowers with very short calyx lobes and small black fruit with 'eugenioide' (undivided) embryos; 4) the *E. florida* alliance composed of *E. florida, E. angustissima, E. cristaensis, E. complicata* and perhaps *E. moraviana,* characterized by umbel-like racemes, small flowers with short calyx lobes in which the inner pair cover the young flower bud and small black fruit with

'eugenioide' undivided embryos; 5) *E. klotzschiana,* an isolated species distinguished by large flowers with the four calyx lobes hiding the petalar globe in mature bud, 2-4 locular ovary with a large number of ovules and large, yellow pear-shaped fruits with large, cream false plano-convex embryos.

The genus *Pseudeugenia* cannot in my opinion be maintained. The character of 2-ovulate locules is matched by other species such as *E. dysenterica, E. angustissima* and *Eugenia myrcianthes* var. *nana,* albeit not consistently so; however, in *Eugenia beaurepaireana* and *'Hexachlamys ' itatiaeae* the number of ovules is consistently reduced to 2 per loculus. The character of two-ovulate locules was given great emphasis by McVaugh (1968) as a generic marker, but it occurs sporadically in *Eugenia* and in other genera which usually have more than 2 ovules, such as *Blepharocalyx,* usually in small-flowered species.

Key to flowering material

1a Trees.....2
1b Shrubs to 1.5 m.....9

2a Inflorescences in lax 3-flowered dichasia.....16. *Eugenia pyriformis*
2b Inflorescences solitary flowers, normal, precocious and umbel-like racemes..3

3a Bracteoles hyaline, deciduous in young bud before anthesis; ovary with 4-8 ovules.....6.*E. dysenterica*
3b Bracteoles persisting during flowering; ovary with more than 8 ovules.....4

4a Pedicels c. 1-5 cm, usually above 1.5 cm; bracteoles subfoliaceous, c. 6-15 mm, widely ovate to subcordate, hiding the flower bud or nearly so.....3. *E. bracteata*
4b Pedicels c. 0.5-2 cm, usually below 1.5 cm; bracteoles c. 0.5-2.5 mm, ovate, triangular or linear, never hiding the flower bud.....5

5a Ovaries glabrous.....6
5b Ovaries with a sparse to dense indumentum.....7

6a Inflorescences umbel-like racemes (peduncle + axis to c. 1 cm at most).....18
6b Inflorescences normal racemes or panicles with 3- c. 30 fls.....21

7a Leaves above with the second and third order venation forming a raised reticulum; petals with a pink flush, noticeably glandulate....12. *E. piauhiensis*
7b Leaves above with the second order venation only (laterals and marginal) venation raised; petals white, barely glandulate.....8

8a Young branches reddish-brown, with a shiny or waxed appearence, sometimes with minute strigulose, colourless or whitish hairs; the inner pair of calyx lobes reaching to the middle of the petal globe or nearly so; hairs on ovary whitish.....14. *E. punicifolia*
8b Young branches pale and dull with a tawny pubescence; calyx lobes below the middle of the petal globe; hairs on ovary tawny.....15. *E. uruguayensis*

9a Leaves acicular to linear-lanceolate, glabrous, mostly 10-50 times as long as wide, the widest c. 7 times as long as wide; flowers glabrous.....1. *E. angustissima*
9b Leaves of various shapes and degrees of pubescence, mostly c. 1-6 times as long as wide, sometimes to 20 times as long as wide but then flowers pubescent.....10

10a Bracteoles 2.5-14.5 mm, ovate to subcordate, completely hiding the ovary; leaves glabrous or nearly so, rather shiny above.....11
10b Bracteoles usually 0.5-2.5 mm, or if larger (-9 mm) linear, not hiding the ovary; leaves various.....12

11a Leaves usually of an obovate or oblanceolate type, widest above the middle; bracteoles 6-14.5 mm; sepals obscurely glandular.....3. *E. bracteata*
11b Leaves oblong-lanceolate, widest at the middle; bracteoles 2.5-6.5; sepals with large noticeable glands.....8. *E. glandulosa*

12a Buds completely pubescent; full-grown leaves on flowering material usually pubescent at least below (mature leaves sometimes glabrous).....13
12b Buds with the hypanthium on the inferior ovary much more pubescent than the calyx lobes (these frequently glabrous although sometimes ciliate); full-grown leaves on flowering material usually glabrous (young leaves sometimes pubescent).....14

13a Buds 6-16 mm long; leaves c. 5-13 cm long; ovary 2-4 locular, with c. 50-100 ovules.....9. *E. klotzschiana*
13b Buds, leaves or both much smaller; ovary 2-3 locular, with less than 25 ovules 15

14a Flowers all solitary or in normal racemes that end in pair of flowers or in a pedicellate flower.....17
14b Flowers in umbeliform racemes (peduncle + axis = 1 cm at most), at least in part (some solitary flowers may be present).....18

15a Flowers exclusively solitary, in precocious racemes or in 3-flowered dichasia; pedicels c. 15-30 mm long; bracteoles linear, longer than the ovary, opposite or subalternate; ovary locules sericeous within.....16
15b Flowers in normal or umbeliform racemes, solitary flowers present but never exclusively so; pedicels c. 2-15 mm; bracteoles ovate to deltoid, about as long as the ovary, strictly opposite; ovary locules glabrous within.....17

16a Leaves c. 1.5-5 times as long as wide, pubescent below even at maturity; flowers concentrated at distal nodes; ovules usually more than 10.....10. *E. lutescens*
16b Leaves c. 5-20 times as long as wide, glabrescent below with age; flowers concentrated at proximal nodes; ovules usually less than 10.....11.*E. myrcianthes* var. *nana*

17a Leaves below, branches, hypanthium over inferior ovary or vegetative buds (usually all four) with a sparse to dense pubescence of soft whitish hairs.....5. *E. cristaensis*
17b Leaves glabrous or virtually so; ovary and inflorescence bracts glabrous or with minutely strigulose rufous hairs.....4. *E. complicata*

18a Young branches frequently with a waxed or varnished look; petioles stout c. 1-4 mm long; petals white, barely glandulate.....19
18b Young branches dull; petioles slender to stout, c. 3-6.5 mm long; petals with a pink flush, noticeably glandulate.....20

19a Umbel-like racemes with (1-)3-6(-10) flowers; sepals eciliate, the slightly larger inner pair reaching well below the middle of the petal globe.....2. *E. bimarginata*
19b Umbel-like racemes with (1-)2-3(-5) flowers; sepals ciliate, the slightly larger inner pair reaching to the middle of the petal globe or nearly so.....14. *E. punicifolia*

20a Leaves above with the second and third order venation forming a raised reticulum, sparsely glandular under a lens; staminal disk usually pubescent on a ring which is raised above the base of the calyx lobes....12. *E. piauhiensis*
20b Leaves above with the second order venation only (laterals and marginal) slightly raised, densely glandular under a lens; staminal disk nearly flush with base of the calyx lobes.....13. *E. piloesis*

21a Branches almost white; leaf margins sometimes with a few almost imperceptible teeth; pedicels strictly opposite, delicate, c. 0.25.....17. *E. moraviana*
21b Branches pale brown to cream; leaf margins entire; pedicels opposite and subalternate 0.25-1.....7. *E. florida*

Key to sterile and fruiting material

1a Trees.....2
1b Shrubs below 1.5 m.....11

2a Smallish (to c. 3 m) trees in cerrado *sensu stricto* to campo.....3
2b Large trees in cerradão and forest.....7

3a Bark of trunk thick, corky, deeply fissured in a grid-like pattern, dehiscent in small blocks; leaf venation densely reticulate, not forming a marginal vein; mature fruit pale yellow green, round or oblate, glabrous, glaucous, the persistent calyx lobes membranceous and dry 2.5-5 mm long.....6. *E. dysenterica*
3b Bark of trunk thinnish, peeling or flaking; leaf venation either not densely reticulate or forming a discernible, arched or nearly straight marginal vein; mature fruit frequently black, reddish or orange, if yellow either densely pubescent or the calyx lobes green and 5-9 mm long.....4

4a Mature leaves strongly coriaceous, 1-2 times as long as wide, rotund to widely elliptic with a rather conspicuous cartilagineous margin.....2. *E. bimarginata*
4b Mature leaves cartaceous, lacking a cartilagineous margin, usually 2-5 times as long as wide, rarely the widest leaves below 2 times as long as wide.....5

5a Leaves usually widest at the middle, with secondary and third order venation raised above forming a reticulum; fruit black, roundish, below 1 cm.....12. *E. piauhiensis*
5b At least some of the leaves usually widest above the middle with secondary

venation only raised above; fruit orange to deep cherry red or if black then rather elongate and above 1 cm.....6

6a Bark of trunk smooth and pale; leaves with venation raised more below than above petioles (0-)2-10 mm, commonly above 4 mm; fruits c. 2-3.5 cm long with 2 subfoliaceous bracteoles at base.....3. *E. bracteata*
6b Bark of trunk reddish-brown, peeling like very thin paper; leaves with venation raised equally above and below; petioles 1-4 mm, rarely reaching 4 mm; fruits c. 1-1.5 cm with 2 small deltoid or ovate bracteoles at base.....4.*E. punicifolia*

7a Leaves with a dense, sericeous pubescence below; fruits yellow when mature, pubescent.....16. *E. pyriformis*
7b Leaves glabrous, fruits red, black or if yellow glabrous.....8

8a Leaves with second and third order venation raised above forming a reticulum; fruits round, black to 1 cm.....12. *E. piauhiensis*
8b Leaves with second order venation (laterals and marginal vein) only raised above; fruits various.....9

9a Leaves usually obovate or oblanceolate, widest above the middle, drying coppery-tan to bright yellow-ochre or yellow-green; leaf apex usually rounded or obtuse (if acuminate barely so with a thick, short round-tipped acumen); fruits 2-3.5 cm.....3. *E. bracteata*
9b Leaves usually of an ovate, elliptic or lanceolate type, widest at the middle, drying in pale or somber tones of green and brown; leaf apex never rounded, obtuse to acuminate with a long-tapering blunt-tipped acumen; fruit usually below 1 cm, black.....10

10a Petioles 4-6 mm; leaves with lateral veins forming an almost straight marginal vein that runs almost parallel 1-3 mm from the leaf margin.....15. *E. uruguayensis*
10b Petioles 6-12 mm; leaves with lateral veins forming an arching marginal vein that curves into the next lateral, 4-9 mm distant from the margin at the most distant point .....7. *E. florida*

11a Leaves large, 5-15 cm, obovate or oblanceolate, 1.5-3 times as long as wide, velutinous when young, glabrous, eglandular, and strongly coriaceous at maturity, the lateral veins in 7-12 pairs forming an arching marginal vein that curves away from the leaf margin into the next lateral, 4-10 mm distant from the margin at the most distant point, ending in a mucron at the leaf apex.....9. *E. klotzschiana*
11b Leaves with other combinations of size, shape, texture and pubescence, the lateral veins various, the marginal vein indistinct, running close and parallel to the leaf margin or weakly arched, rarely more than 4 mm from the leaf margin at the most distant point, not ending in a mucron at the leaf apex.....12

12a Leaves acicular to narrow-lanceolate at least 6 times as long as wide, the narrowest leaves usually much narrower.....13
12b Leaves of various other shapes, only the very narrowest leaves occasionally reaching 5 times as long as wide.....15

13a Young branches, if pubescent, with very fine white hairs perceptible to the

naked eye; leaves with sparse hairs when young, widest at the middle or above, 6-22 times as long as wide; fruits various.....14

13b Branches, if pubescent, with minute yellowish hairs imperceptible to the naked eye; leaves glabrous, of more or less equal width along most of its length, 6-50 times as long as wide; fruits shiny black; embryo undivided, bright green when fresh.....1. *E. angustissima*

14a Leaves rarely more than 5 cm long, with dark impressed glands above when mature, the venation below either obscure or the two lower laterals equalling the midvein, thus a weakly trinervate leaf.....5. *E. cristaensis*

14b Leaves frequently more than 5 cm long, with sparse slightly raised glands when mature, the laterals weaker than the midvein.....15

15a Leaves glabrous to pubescent, of various shapes, almost always 2.1-6 times as long as wide; apex various; base, if subcordate, then leaves pubescent or not coriaceous.....16

15b Leaves glabrous, suborbicular to wide-elliptic, 1-2 times as long as wide, the apex rounded to subcordate, coriaceous when mature.....22

16a Leaves densely pubescent below even at maturity, with yellowish hairs; base cordate to acute; apex acute to barely acuminate, fine-tipped; fruit round, pale yellow or pale orange densely pubescent when mature.....10. *E. lutescens*

16b Leaves usually glabrous or with sparse hairs, if densely pubescent the hairs whitish-pink and the apex blunt-tipped; apex various; fruits usually red or black when mature or if yellow, glabrous.....17

17a Leaves glabrous above with secondary and third order venation equally raised forming a reticulum; petioles 3-6.5 mm; fruit black, below 1 cm; seed with a thin transversal groove at the hilum.....12. *E. piauhiensis*

17b Leaves above at most with the second order (laterals and marginal) raised; petioles various; seed without a thin transversal groove at the hilum.....18

18a Leaves 3-13 cm long, drying bronze-brown to yellow-ochre, obovate or oblanceolate; apex rounded or with a thick, rounded acumen; base attenuate into a nearly absent to 10 mm long petiole.....3. *E. bracteata*

18b Leaves 1-8.5 cm, drying very pale brown, very pale green or very dark brown, usually elliptic or ovate, if of the above shape then petiole 1-4 mm.....19

19a Young branches frequently reddish-brown with a waxed or varnished appearence unless puberulous; leaves with secondary venation (laterals and marginal) equally raised on both surfaces and sparse glands..4. *E. punicifolia*

19b Young branches pale cream to grey, dull; leaves with venation rather obscure or densely glandular either above or below.....20

20a Leaves below eglandular or with sparse glands obscure to the naked eye.....5. *E. cristaensis*

20b Leaves below densely glandular to the naked eye.....21

21a Leaves above with midvein sulcate for the entire length of the leaf; fruits yellow, 3-4.5 cm, attenuate at both ends.....8. *E. glandulosa*

21b Leaves above with midvein flush or somewhat raised, if sulcate lightly so near base; fruit roundish, purplish-black.....4. *E. complicata*

22a Leaves above densely glandular even to the naked eye; fruit and seed attenuate at base.....13. *E. piloesis*
22b Leaves above sparsely glandular under a lens; fruit and seed round or slightly elliptic.....2.*E. bimarginata*

1. ***Eugenia angustissima*** Berg, *Fl. Bras.* 14(1) *Suppl.* : 569. 1859. Type. Brazil. São Paulo: Rio Pardo, *Riedel* s. n. (Holotype LE n. v., Isotype F!) (**Figs. 3.8 & 4.2 a**)

Eugenia herbacea Berg nec A. Chevalier, *Fl. Bras.* 14(1) *Supl.* : 570. 1859. Type. Brazil. São Paulo: 'in campis arenosis ad Rio Pardo' *Riedel* s. n. (Holotype LE n. v., Isotype F!)

Shrub 0.2-0.7 m, glabrous except for the young branches which are frequently puberulous. Mature **leaves** sometimes in fascicles, sessile to subsessile, 5-60 x 0.5-1.5 mm, 7-53 times as long as wide, aciculate to linear; apex rounded to acute; base rounded to attenuate; petiole 0.5-1 x 0.5 mm. **Flowers** 1(-2), axillary; bracts absent; bracteoles mostly persistent in the fruit, 0.75-3(-17) mm, ovate to linear, acute or rounded, sometimes dislocated to the middle of the pedicel, or an extra pair of sterile bracteoles in the middle of the pedicel, or expanded into normal leaves; pedicels 4.5-20 x 0.25 mm; mature buds 3-8 x 2-6 mm, pear-shaped; anthesis occurs as the 4 sepals open. Calyx lobes equal to subequal, 1-1.75 mm, deltoid to ovate, acute or obtuse, explanate after anthesis, glandular, ciliate to slightly ciliate, the outer pair sometimes slightly longer; hypanthium not prolonged above stylar insertion. Petals 2.5-7.5 mm, pale pink in bud, glandular, ciliate or not. Staminal disk 1.25-2.5 mm across, flat, square or circular, stamens 27-33 in 2-3 irregular whorls, 2.5-6.5 mm; anthers 0.5 mm, roundish, with large apical glands. Style 2.5-7 mm, the tip curved in bud; stigma truncate; ovary 1-1.5 mm; locules 2; ovules 5-7, 2-4 per loculus. **Berry** maturing pale yellow, deep red and finally reddish black, 10-12 mm long, roundish to very slightly obovate, crowned by the upright or incurved dry calyx lobes; epicarp shiny; pericarp fleshy, soft; seeds 1, 6-8 mm, reniform; testa silky beige to white, dark brown around the hilum, membranaceous; embryo eugenioide, bright green, densely glandular.

Examined material - **Brazil. Distrito Federal:** (Reserva Ecológica do) Jardim Botânico de Brasília, 1125 m, 29 Aug 1986, *Equipe do Jardim Botânico de Brasília*

725 (HEPH); Córrego Cabeça do Veado, 27 Aug 1976, *Ratter & Fonsêca* 3487 (E, UB); **Goiás:** Inter Cavalcante et Conceição, *Burchell* 8026 (K); Chapada da Mangabeira, Sep 1839, *Gardner* 3182 (F, K); Near Alto Paraíso de Goiás, 7 Oct 1980, *Ratter & Ribeiro* 4510 (E); 171 km de Jataí na Rodovia BR-364 direção Rondonópolis, Oct 1983, *Rodrigues* 10368 (UEC); **São Paulo:** Mogi-Guaçú, 22 Sep 1976, *Gibbs & Leitão Filho* 2898 (UEC); Rio Pardo, *Riedel* s. n. (F); Rio Pardo, *Riedel* s. n. (F); **Mato Grosso do Sul:** Selvíria, 5 Nov 1985, *Tamashiro et al.* 124 (UEC). **Paraguay. Caaguazú:** Caaguazú, Jun 1874, *Balansa* 1323 (K); **Cordillera:** Atyrá, Dec 1902, *Fiebrig* 583 (E).

Distribution - A core and southern cerrados region taxon which occurs in the Distrito Federal, Goiás, western Mato Grosso and São Paulo. The habitats cited by collectors are campo sujo, cerrado and cerrado alto, which confirms my observations that it occurs in almost any kind of cerrado.

Discussion - *Eugenia angustissima* and *E. herbacea* were described consecutively in the *Supplementum* to *Flora Brasiliensis,* both based on Riedel collections from Rio Pardo (this locality I have taken to be what is now São José do Rio Pardo in São Paulo, as several other Riedel collections fix Rio Pardo as being in that state). I have chosen the former name because it has been occasionally used for the species, while the latter, as far as I know, has not and is also an earlier homonym of *E. herbacea* A. Chevalier, an African species. *E. angustissima* is frequently confused with *E. myriophylla,* an endemic to the Serra da Caraça in Minas Gerais, which it resembles very closely, an error that began with Berg in the *Flora Brasiliensis* (1857) citing the Gardner n. 3182 collection, which belongs to *E. angustissima,* as *E. myriophylla* (*Myrciaria myriophylla* to him).

2. ***Eugenia bimarginata*** DC., *Prodromus* 3: 271. 1828. Type. Brazil. Minas Gerais: *Martius* s. n. (Holotype M!) **(Fig. 3.9)**

Syn.: *Eugenia umbellata* DC. non Spreng., *Prodromus* 3: 273. 1828. nom. illeg. Type. Brazil. Goiás: 'In silvulis regionis Vão do Paranan, floret Octobri' *Martius* s. n. (Holotype M? n. v.)

E. bimarginata var. *impunctata* Camb., *Florae Brasiliensis Meridionalis* 2: 347. 1833. Type. Brazil. Minas Gerais: 'In campis prope praedium vulgo

Fazenda do Capitão Pedro' *St. Hilaire* s. n. (Holotype P? n. v.)

E. bimarginata var. *tomentosa* Camb., *Florae Brasiliensis Meridionalis* 2: 347. 1833. Type. Brazil. Locality unknown (Label lost fide Cambessèdes, 1833): *St. Hilaire* s. n. (Holotype P? n. v.)

E. rubrocincta Berg, *Fl. Bras.* 14(1): 291. 1857. Type. Brazil. São Paulo: Prope urbes Pantago et São Paulo, *Sellow* 5873 (Holotype B - destroyed, Isotype K!)

E. bimarginata Berg non Mart. ex DC., *Fl. Bras.* 14(1): 291. 1857. nom illeg. Type. Brazil. São Paulo: *Sellow* s. n. (Holotype B - destroyed)

E. dicrossa Berg, *Fl. Bras.* 14(1):192. 1857. nom. illeg. Based on *E. bimarginata.*

E. dicrossa var. *parvifolia* Berg, *Fl. Bras.* 14(1): 292. 1857. nom. illeg. to replaced by *Eugenia dicrossa* var. *dicrossa.* Based on *Eugenia bimarginata.*

E. dicrossa var. *longifolia* Berg, *Fl. Bras.* 14(1): 292. 1857. Based on *Eugenia umbellata* DC. non Spreng.

E. dicrossa var. *latifolia* Berg, *Fl. Bras.* 14(1): 292. 1857. Type. Brazil. Goiás: 'Inter Capão et Alferes Melchior' *Pohl* 1015 (Holotype W n. v. Isotype K!)

E. bimarginata var. *rubrocincta* (Berg) Kiaersk., *Symb. Fl. Bras. Centr.* 39: 132. 1893. Based on *E. rubrocincta* .

E. bimarginata var. *umbellata* (Berg) Kiaersk., *Symb. Fl. Bras. Centr.* 39: 132. 1893. Based on *E. umbelata* DC.

Small **tree**, shrub or subshrub 0.4-2 m, glabrous or rarely new growth, petioles, leaves below and inflorescence pubescent. Hairs white, very short, soft. Young branches pale straw to orange brown, the bark folded and waxy. Mature **leaves** 2.7-10.3 x 1.4-9.6 cm, 1.1-2.2 times as long as wide, wide-elliptic to suborbicular or sometimes cordate or slightly obovate; apex obtuse, rounded, rarely subacuminate or emarginate; base round, subcordate or rarely obtuse; petiole 1.5-4.5 x 2-3 mm. Umbel-like raceme, axillary or at basal, leafless nodes to 2.5 cm; peduncle or axis absent to c. 7 x 2.5 mm, much shorter and stouter than the pedicels; **flowers** 1-10; bracts clustered at raceme base; bracteoles mostly persistent and explanate in the fruit, 0.75-2 mm, navicular to almost rounded; pedicels 3-21 x 0.5-1.25 mm; mature buds 3.25-6.5 x 2.5-4.5 mm, capitate; anthesis occurs as the 4 sepals open. Calyx lobes in two subequal pairs, 1-2.5 mm, ovate, barely acute to rounded, ciliate to eciliate; hypanthium not prolonged above stylar insertion. Petals 3-4.5 mm, white, round to oblate, slightly ciliate. Staminal disk 1.75-3 mm across, circular, flat; stamens c. 62-92 in 2-3 irregular whorls, 2.5-6 mm; anthers 0.5-1 mm, oblong to elliptic, with small apical glands. Style 7 mm; stigma truncate; ovary 2-2.25 mm; locules 2;

ovules c. 23, 11-12 per loculus. **Berry** maturing yellow and finally bright red, 10-15 mm long, slightly elongated, crowned by the upright and incurving calyx lobes which are rather cartilagineous at the margins; epicarp shiny; pericarp thin; seeds 1, 9-10 mm, elliptic; testa dark straw coloured to very pale brown, shiny, crustaceous; embryo eugenioide.

Examined material- **Brazil. Distrito Federal:** Reserva Ecológica do IBGE, 18 May 1988, *Alvarenga* 46 (IBGE); Rodovia Brasília-Paracatu, 19 Sep 1966, *Heringer* 11191 (UB); Bacia do Rio São Bartolomeu, 17 Mar 1980, *Heringer & Filgueiras* 3987 (IBGE); Jardim Botânico de Brasília, 1100 m, 8 Apr 1980, *Heringer & Filgueiras* 4261 (IBGE); Bacia do Rio São Bartolomeu, 19 May 1981, *Heringer & Filgueiras* 6956 (IBGE); Ribeirão Agua Doce ou Cafuringa, 800 m, 17 Jul 1980, *Kirkbride & Kirkbride* 1332 (UB); Fazenda Agua Limpa, 5 Aug 1976, *Ratter & Fonsêca* 3396 (E, UB); **Goiás:** 1896, *Glaziou* 21180 (K); Fazenda do Palmital (fide Glaziou 1908), 1896, *Glaziou* 21181 (K); 1818, *Martius* s. n. (M); Inter Capão et Alferes Melchior, *Pohl* 1015 (K); **Minas Gerais:** Alpinópolis, 26 Jul 1982, *Alvarenga et al.* 3307 (UEC); Campo do Meio, 14 Sep 1983, *Carvalho et al.* 2738 (UEC); Rosário, 5 Oct 1982, *Carvalho et al.* s. n. (UEC); Montes Claros, 14 May 1977, *Gibbs & Abbot* 5112 (UEC); *Glaziou* 16981 (K); Lavras, 9 Dec 1980, *Leitão Filho & Shepherd* 11731 (UEC); *Martius* s. n. (M); *Martius* s. n. (M); Pimenta, 3 May 1984, *Pereira* 3797 (UEC); **São Paulo:** Botucatú, 6 May 1986, *Bicudo & Campos* 1079 (UEC); *Burchell* 4031 (K); *Burchell* 4664 (K); *Burchell* 4681 (K); Mogi-Guaçú, 25 May 1977, *Gibbs & Leitão Filho* 4768 (UEC); São Paulo, 'Environs de Rio de Janeiro' (surely erroneous), Feb 1882, *Glaziou* 12726 (K); Mogi-guaçu, 17 Aug 1977, *Morais & Sazima* 5677 (UEC); Santo Antonio da Posse, 13 Nov 1978, *Ratter & Gouvêa* 4312 (E, K); Araracoara, Batataes et Villa Franca, Jun 1834, *Riedel* 2258 (K); Prope urbes Pantago et São Paulo, *Sellow* 5873 (K); Oppidium Jundiahy, *Sellow* s. n. (K); Ipiranga, 13 Aug 1905, *Usteri* 1592 (K); Mogi-Guaçú, 17 Feb 1978, *Yamamoto* s. n. (UEC); **Piauí:** *Gardner* 2602 (F); **Paraná:** Arapotí, 11 Oct 1968, *Hatschbach* 19982 (UEC); **Mato Grosso do Sul:** Fazenda Paraíso, 12 Nov 1979, *Otaciano* 50 (UEC); **Rio de Janeiro:** Environs de Rio de Janeiro, 1882, *Glaziou* 13873 (K); **Locality unknown:** 1894, *Glaziou* 20318 (K).

Vernacular names - Araçá (Distrito Federal). The fruits are rather insipid.

Distribution - In the Distrito Federal, Goiás, Mato Grosso do Sul, Minas

Gerais, Pico das Almas in Bahia, São Paulo, western Paraná and perhaps Rio de Janeiro, down along the western rocky campos of Paraná into Corrientes in Argentina (Legrand 1941, 1977). One of the commonest and most well-distributed Cerrado regions taxa of Myrtaceae, it can occur in campo limpo to cerrado sensu stricto.

Discussion - The names *Eugenia umbellata* and *E. bimarginata,* both published in the *Prodromus* by De Candolle (1828) have equal priority for this species. The former, however, is a later homonym of *E. umbellata* Sprengel (1821), so *E. bimarginata* is the oldest legitimate name for this species.

Berg (1857) illegally introduced the epithet *dicrossa* when uniting the two De Candolle names; *E. umbellata* is cited as *E. umbellaris,* respecting De Candolle's correction. Berg gave varietal status to the two De Candolle species and created a third variety. He anotated the type specimen of *E. bimarginata* as *E. dicrossa* var. *parvifolia* (which I have seen) and presumably that of *E. umbellata* as *E. dicrossa* var. *longifolia.* In the interest of taxonomic stability, I have chosen to lectotipify *E. dicrossa* by var. *parvifolia,* thereby reducing *E. dicrossa* to a nomenclatural synonym of *E. bimarginata.*

On the same page as *E. dicrossa,* Berg describes his own closely allied *E. bimarginata,* which must be rejected as a later homonym of *E. bimarginata* DC., to which, in my opinion, it is also taxonomically synonymous, as are also two other Berg species, *E. rubrocincta* and *E. subcordata. E. bimarginata* Berg was separated from *E. bimarginata* DC. by Berg by its leaves with non-cordate bases and *E. rubrocincta* by its slightly acuminate leaves and puberulous inflorescences. *E. subcordata* Berg was said to differ by the slightly pubescent inflorescences with a short rhachis 6-14 mm long, but these characters are matched by the Glaziou n. 16981 collection from Minas Gerais. The c. 40 specimens I examined showed continuous, non-geographical variation for these characters. An arboreal, small-leaved and pubescent species from Southern São Paulo and Minas Gerais, closely allied to *E. bimarginata,* is usually identified as *E. livida* Berg, of which I have not seen the type: it may also be referable to this species and is probably the forest entity from which *E. bimarginata* derived.

3. ***Eugenia bracteata*** Vell. nec (Willd.) DC., *Flora Fluminensis* 209, Tab. 40. 1825. Type. Brazil. Rio de Janeiro: 'Habitat ad scaturiginem fluvii dicti

Taguahy, floret Julio' *Vellozo* (?) s. n. (originally R, since presumably lost Tab. 40) **(Figs. 3.10 & 4.2 b)**

Syn. : *Myrtus aggregata* Vell., *Flora Fluminensis* 215, Tab. 65. 1825. **nov. syn.** Type. *Vellozo* (?) s. n. (originally R, since presumably lost Tab. 65)

? *Eugenia involucrata* DC., *Prodromus* 3: 264. 1828. **nov. syn.** Type. Brazil: *Martius* s. n. (Holotype M? n. v.)

? *E. calycina* Camb., *Florae Brasiliensis Meridionalis* 2: 352. 1833. **nov. syn.** Type. Brazil. Goiás: 'In campis prope praediolum vulgo Sitio de Gregório Nunes in parte australi provinciae. Florebat Augusto.' *St. Hilaire* s. n. (Holotype P? n. v.)

? *Phyllocalyx calystegius* Berg, *Fl. Bras.* 14(1): 331. 1857. **nov. syn.** Type. Brazil. São Paulo: *Sellow* s. n. (Holotype B - destroyed)

P. strictus Berg, *Fl. Bras.* 14(1): 330. 1857. Type. Brazil. Rio de Janeiro: *Sellow* 257. (Holotype B - destroyed, Isotype K!)

? *P. calycinus* (Camb.) Berg, *Fl. Bras.* 14(1): 329. 1857. **nov. syn.** Based on *Eugenia calycina.*

P. cerasiflorus Berg, *Fl. Bras.* 14(1): 330. 1857. Nom. illeg. Type. Brazil. Rio de Janeiro: *Sellow* s. n. (Holotype B - destroyed, Isotype K!)

? *P. involucratus* (DC.) Berg, *Fl. Bras.* 14(1): 330. 1857. **nov. syn.** Based on *Eugenia involucrata* .

? *P. laevigatus* Berg, *Fl. Bras.* 14(1): 329. 1857. Type. Brazil. Rio de Janeiro: 'Ad urbem Rio de Janeiro' *Schott* 5834 (Holotype W? n. v.)

? *P. regelianus* Berg, *Fl. Bras.* 14(1) *Supl.:* 591. 1859. Type. Brazil. Minas Gerais: 'Inter Rio das Velhas et Paranahyba, florebat Augusto' *Riedel* s. n. (Holotype LE n. v.)

? *Eugenia aggregata* (Vell.) Kiaersk., *Symb. Fl. Bras. Centr.* 39: 162. 1893. Based on *Myrtus agregata* .

? *E. lundiana* Kiaersk., *Symb. Fl. Bras. Centr.* 39: 162. 1893. Based on *Phyllocalyx regelianus.*

E. stricta (Berg) Kiaersk., *Symb. Fl. Bras. Centr.* 39: 163. 1893. Based on *Phyllocalyx strictus* .

Tree, shrub or spreading subshrub 0.1-10 m, predominatly glabrous. **Hairs** whitish (reddish on vegetative buds and very young vegatative growth), short and stiff; new growth, ovary and usually staminal disk strigulose. Bark of trunk smooth and pale. Mature **leaves** 3.3-13 x 1-4.5 cm, 2.1-5 times as long as wide,

obovate, elliptic or oblanceolate; apex rounded to barely acuminate, the acumen thick, obtuse, rounded or minutely emarginate at extreme tip; base acute to cuneate, sometimes decurrent on petiole; petiole (0-)2-10 x 1-2 mm. **Flowers** solitary or usually in a 2-6 flowered precocious raceme; raceme apical or lateral, 2.5-14 cm including young leaves, peduncle 0-4 mm; bracts and bracteoles mostly persistent in the fruit, bracts lanceolate; bracteoles foliaceous, 6-14.5 x 5-12 mm, ovate to cordate, slightly ciliate or not; pedicels 9-51 x 0.5-1.25 mm; mature buds 6-13 x 5.5-9 mm, the ovary and petal globe hidden by the calyx lobes and bracteoles; anthesis occurs as the 4 sepals open. Calyx lobes in two subequal pairs, 5.5-14 mm, oblong, obtuse, forming an explanate cross at anthesis, slightly ciliate or not; hypanthium not prolonged above stylar insertion. Petals white, 9-19 mm, roundish, usually ciliate. Staminal disk 5-7.5 mm across, flat, square, stamens 116-192 in 4-8 irregular whorls, 7-18 mm, erect in bud; filaments pale pink; anthers beige, 0.75-1.5 mm, roundish to elliptic, lacking an apical gland. Style 7.5-19 mm, the tip slightly curved in bud; stima truncate or barely expanded; ovary 3-4 mm; locules 2; ovules 35-48 on a central placenta, 16-28 per loculus. **Berry** maturing greenish white, orange-red and finally dark reddish-black, 20-35 mm including calyx lobes, slightly elongated to oblong, crowned by the green, erect or slightly flaring calyx lobes; seeds 1(-3), 9-16 mm, roundish to elliptic; testa pale silky cream with a white, rounded ridge running along the dorsal portion, pergaminaceous; embryo with an inter-cotyledonary split on one side only, the cotyledons not separating.

Examined material - **Brazil. Distrito Federal:** Entre Sobradinho e o Centro de Pesquisa Agropecuária do Cerrado, 1200 m, 5 Jan 1983, *Almeida* 599 (IBGE); Fazenda Agua Limpa, 21 Nov 1979, *Cesar* 240 (UB); ibid., 21 Nov 1979, *Cesar* 255 (E); Jardim Botânico de Brasília, 1100 m, 20 Aug 1986, *Equipe do Jardim Botânico de Brasília* 706 (HEPH); Campus da Universidade de Brasília, 24 Apr 1972, *Ferreira* 1368 (HEPH); Parque do Gama, 3 Mar 1972, *Ferreira* 1591 (HEPH); Reserva Biológica das Aguas Emendadas, 16 Jul 1971, *Ferreira* 850 (HEPH); Fazenda Agua Limpa, 4 Mar, *Haridasan & Batmanian* 137 (UB); Rio São Bartolomeu, 15 Nov 1973, *Heringer* 13000 (UB, UEC); Estação Experimental de Biologia da Universidade de Brasília, 24 Oct 1977, *Heringer* 15734 (IBGE); Jardim Zoológico, 6 Aug 1977, *Heringer* 16911 (IBGE); Estação Experimental de Biologia da Universidade de Brasília (cultivada), 27 Sep 1980, *Heringer* 17960 (IBGE); Reserva Ecológica do IBGE, 20 Sep 1979, *Heringer & Filgueiras* 2020 (IBGE); Bacia do Rio São Bartolomeu, 10 Oct 1979, *Heringer & Filgueiras* 2215

(IBGE); Estação Biológica da Universidade de Brasília (cultivada), 17 Nov 1980, *Heringer & Filgueiras* 5730 (IBGE); Bacia do Rio São Bartolomeu, 17 Nov 1980, *Heringer & Filgueiras* 5754 (IBGE); Reserva Ecológica do IBGE, 22 Dec 1980, *Heringer & Filgueiras* 5918 (IBGE); ibid., 11 Oct 1978, *Heringer & Paula* 667 (IBGE); Parque do Guará, 20 Sep 1962, *Heringer* 8978 (HEPH, UB); Brasília, 1 Jan 1963, *Heringer* 9087 (HEPH, UB); Fundação Zoobotânica, 30 Aug 1964, *Heringer* 9755 (K, UB); Parque Nacional de Brasília, 18 Aug 1964, *Heringer & Belém* 9777 (UB); Fundação Zoobotânica, 8 Sep 1964, *Heringer* 9803 (UB); Fazenda Agua Limpa, 1100 m, 6 Nov 1981, *Kirkbride* 1579 (UB); Reserva Biológica das Aguas Emendadas, 1100 m, 22 Sep 1982, *Oliveira* 109 (HEPH); Reserva Ecológica do IBGE, 13 Jul 89, *Pereira Neto & Azevedo* 351 (IBGE); Reserva Biológica de Aguas Emendadas, 1963, *Pereira* 687 (IBGE); Reserva Ecológica do IBGE, 4 Oct 1983, *Pereira* 809 (IBGE); Jardim Botânico de Brasília, 1100 m, 21 Oct 1986, *Proença* 618 (HEPH); Jardim Botânico de Brasília, 1100 m, 21 Oct 1986, *Proença* 620 (HEPH); Fazenda Agua Limpa, 1 Sep 1976, *Ratter & Fonsêca* 3522 (UB); Reserva Ecológica do IBGE, 20 Oct 1986, *Silva* 203 (IBGE); ibid., *Silva* 204 (IBGE); **Goiás:** Luziânia, 20 Feb 1975, *Heringer* 14742 (UEC); **Minas Gerais:** Uberlândia, Fazenda do Panga, 16 Sep 1989, *Araújo* 84 (Uberlândia); Patrocíneo, 13 Nov 1988, *Filgueiras & Alvarenga* 1497 (IBGE); **Bahia:** São Desidério, 14 Oct 1989, *Mendonça & Silva* 1518 (A) (IBGE); **Rio de Janeiro:** 1837, *Gardner* 43 (F); Chemin de Macaco à la Tijuca, 3 Aug 1878, *Glaziou* 9440 (K); Parahyba, *Riedel* 344 (K); *Sellow* 257 (K); **Paraná:** Arapotí, 11 Oct 1968, *Hatschbach* 19983 (K); **Rio Grande do Sul:** Morro da Glória perto de Porto Alegre, 22 Sep 1950, *Rambo* 48805 (K); **Locality unknown:** *Burchell* 5832 (K); *Burchell* 5931 (K); *Gardner* 4688 (F).

Vernacular names and uses - Pitanga (Distrito Federal), Pitangueira-do-campo (Minas Gerais), Cereja (São Paulo, Santa Catarina; Legrand 1969), Cerejeira, Cerejeira-do-mato (Santa Catarina, Legrand 1969); Cereza, Guaviyú (Uruguay, Legrand 1943, 1962). The fruits are eaten by the local population. There is a tree of this species which has been cultivated on the Field Station of the Universidade de Brasília for 15 years and which produces abundant fruit.

Distribution - From the Distrito Federal to Goiás, Minas Gerais, São Paulo, Rio de Janeiro, Paraná, Santa Catarina and Rio Grande do Sul, as well as in Uruguay, Missiones in Argentina and nearby Paraguay. This species occurs

throughout the Plate River Basin, with the Distrito Federal possibly its northern limit. In the cerrado Region it is one of the few species that occurs both as a shrub in cerrado *sensu lato* and as a tree in forests, thus making it one of the most ecologically plastic species of Myrtaceae. It seems to be somewhat tolerant of flooding and has been cited by collectors as being a tree in swampy gallery forests, and as a shrub in cerrado-swamp ecotone or on the hummocks of the wet campos de murundús, but it also occurs in more ordinary conditions, such as dry gallery forest, mesophytic forest and in virtually all kinds of cerrado, from campo sujo to cerradão.

Discussion - I have united several names under a poorly-known Vellozo epithet. Vellozo (1825) described this species twice, once as *Myrtus aggregatus* based on a flowering specimen and once as *Eugenia bracteata* based on a fruiting one, noting on the former that 'Flos vel *M.(yrtus)* vel *Eugeniae?* Baccam, quam non vidi, genus determinavit'. Berg (1857) cited both names: *M. aggregatus* as a synonym of his new combination *Phyllocalyx involucratus* (based on *Eugenia involucrata* DC.) and *Eugenia bracteata* as a synonym of his 'new species' *Phyllocalyx cerasiflorus.* Since Berg described 14 new species in *Phyllocalyx,* as well as making 5 new combinations, he greatly added to the uncertainty in application of the Vellozo epithet. At least eight of the Berg names in *Phyllocalyx* have proved synonymous to only two species (Legrand 1969, this study) and I think it unlikely that this group has more than 5 or 6 good species. There has always been some confusion as to effective date publication of the *Flora Fluminensis,* and as this was at least close to De Candolle's *Prodromus,* in the past botanists preferred to adopt the De Candolle epithet and this species is usually known as *E. involucrata.* A well-documented study by Carauta (1973) has shown the effective date of publication to have been no later than May 1825 and Vellozo names have consequently begun to be accepted within the botanical community (Gentry 1975). Many Vellozo illustrations lack enough detail to permit identification, but in the case of this very distinct, common species, I believe there can be no doubt and the rightful Vellozo epithet should be henceforward adopted. The arboreal form has usually been known as *Eugenia stricta* and the shrubby one as *E. calycina* .

4. ***Eugenia complicata*** Berg, *Fl. Bras.* 14(1): 313. 1857. Type. Brazil. Goiás: Chapada de Nossa Senhora d'Abadia, May 1840, *Gardner* 4162 [erroneously

cited as 5162] (Holotype W n. v., Isotype K!) (**Fig. 3.11**)

Syn.: *E. barrerensis* Berg, *Fl. Bras.* 14(1): 313 Tab. 4 fig. 84. 1857. Type. Brazil. Minas Gerais: 'Ad Barreros' *Pohl* 3196 (Holotype W n. v.)

E. brasiliae Legr., *Loefgrenia* 0 (67): 27. 1975. **nov. syn.** Type. Brazil. Distrito Federal: 18 Aug 1959, *Sena* 17 (Holotype US!)

Shrubby **hemixyle**, 0.3-0.8 m, predominatly glabrous. **Hairs** minute, fulvous, rather stiff; vegetative buds and ovaries usually strigulose; young leaves, inflorescence axis, bracteoles and staminal disk with sparse hairs; mature leaves, petioles, calyx lobes, petals, style and mature fruit glabrous. Xylopodium to 1 cm in diameter. Older branches somewhat angular, the bark thin and papery, splitting and flaking at the angles. Mature **leaves** 3-9.5 x 0.8-2.8 cm, 2-5.6 times as long as wide, lanceolate, oblanceolate or linear-lanceolate; apex acute, acuminate or rarely almost rounded; base cuneate to obuse, rarely rounded; petiole 1.25-6 x 1.25-2 mm. **Flowers** usually in a 2-10 flowered raceme, rarely solitary, axillary; raceme apical, axillary or at basal, leafless nodes, 4-7.5(-13.5) cm, usually ending in a pair of flowers flanking an abortive vegetative bud, sometimes in a single pair of young leaves or a solitary, pedicelled flower; peduncle 3-20 mm; bracts and bracteoles mostly deciduous between anthesis and fruit initiation, sometimes persistent in the fruit, the bracts at peduncle base and sometimes a few scattered along the peduncle, lanceolate; bracteoles 1.25-2.5, ovate to lanceolate, obtuse, carinate at base; pedicels (2-)5-15 x 0.5-0.75 mm; mature buds 4-7 x 3.25-5 mm, capitatate; anthesis occurs as the 4 sepals open. Calyx lobes in equal to subequal pairs, 1.5-4 x 1.5-2.5 mm, rounded or obtuse, conspicuously glandular, reflexed at anthesis, densely ciliate to ciliate, the outer pair sometimes smaller, semi-circular to transverse-elliptic, the inner pair sometimes longer, squarish to oblong; hypanthium not prolonged above stylar insertion. Petals white, 6-9 mm, wide-elliptic, conspicuously glandular, reflexed at anthesis, ciliate to slightly ciliate. Staminal disk 3-5 mm across, square, flat or outcurved; stamens 48-110 in 3-5 irregular whorls, 3-10.5 mm; anthers 0.5-0.75 mm, oblong to elliptic, with small apical glands. Style 4.5-9 mm; ovary 1.25-2 mm; locules 2; ovules 9-22, 3-12 per loculus. **Berry** maturing pale yellow-green, streaking with red and finally purplish-black, 10-12 mm long, roundish, crowned by the erect, explanate or diverging but incurved at tip, calyx lobes; epicarp shiny; pericarp thin and fleshy; seeds 1(-3), 6-8 mm, irregularly reniform; testa pale, membranaceous; embryo eugenioide.

Examined material - **Brazil. Distrito Federal:** Area da UnB, 3 Sep 1990, *Azevedo & Alvarenga* 899 (IBGE); Fazenda Agua Limpa,14 Aug 1979, Cesar 698 (E); ibid., 1077 m, 26 Aug 1980, *Dantas & Miranda* 37 (UB); Jardim Botânico de Brasília, 1100 m, 13 Aug 1985, *Equipe do Jardim Botânico de Brasília* 525 (HEPH); ibid., 1100 m, 21 Aug 1985, *Equipe do Jardim Botânico de Brasília* 554 (HEPH); ibid., 1100 m, 20 Aug 1986, *Equipe do Jardim Botânico de Brasília* 707 (HEPH); Reserva Biológica de Aguas Emendadas, 22 May 1972, *Ferreira* 1126 (HEPH); Gama, 20 Jul 1972, *Ferreira* 1576 (HEPH); Reserva Biológica das Aguas Emendadas, 17 Nov 1972, *Ferreira* 981 (HEPH); Reserva Ecológica do IBGE, 23 Aug 1978, *Heringer & Paula* 616 (IBGE, UEC); ibid., 11 Oct 1977, *Heringer & Paula* 648 (IBGE); ibid., 11 Oct 1978, *Heringer & Paula* 654 (IBGE, UEC); ibid., 20 Jul 1981, *Heringer & Filgueiras* 7200 (IBGE, UEC); Horto do Guará, 2 Aug 1961, *Heringer* 8517 (UB); ibid., 25 Sep 1961, *Heringer* 8698 (UB); Parque do Guará, 1 Oct 1963, *Heringer* 9097 (HEPH, UB); Sobradinho, 8 Aug 1964, *Heringer* 9743(A) (UB); Barragem do Paranoá, 8 Aug 1964, *Heringer* 9746 (UB); , Brasília, 14 Aug 1964, *Irwin & Soderstrom* 5107 (UB); Chapada da Contagem, 1000 m, 12 Sep 1965, *Irwin & Souza* 8240 (UB, UEC); Reserva Ecológica do IBGE, 15 Sep 1982, *Pereira* 336 (IBGE); Cristo Redentor, 24 Jan 1990, *Pereira Neto & Oliveira* 564 (IBGE); Córrego Sobradinho, 26 Apr 1963, *Pires & Silva* 9456 (UB); Reserva Biológica das Aguas Emendadas, 1100 m, 17 Jul 1984, *Proença* 392 (HEPH, UB); Jardim Botânico de Brasília, 1100 m, 21 Oct 1986, *Proença* 615 (HEPH); ibid., *Proença* 616 (HEPH); ibid., *Proença* 617 (HEPH); ibid., *Proença* 619 (HEPH); Fazenda Agua Limpa, 6 Jul 1976, *Ratter & Fonsêca* 3252 (E, UEC); ibid., 2 Nov 1978, *Ratter & Ribeiro* 4254 (E); ibid., 14 Aug 1980, *Ratter & Cesar* 4361 (E, UB); ibid., 1000 m, 26 Aug 1980, *Silva & Almeida* 417 (UB); **Goiás:** Chapada de Nossa Senhora d'Abadia, May 1840, *Gardner* 4162 (K); *Glaziou* 21245 (K); **Minas Gerais:** Formoso, Parque Nacional Grandes Sertões, 31 Jul 1989, *Dias & Walter* 69 (IBGE); ibid., *Dias & Walter* 70 (IBGE).

Vernacular names - Gabiroba (Distrito Federal).

Distribution - Possibly a regionally endemic taxon restricted to the Distrito Federal and neighbouring parts of Goiás and Minas Gerais but common in campo sujo to cerrado *sensu stricto* in the Distrito Federal; this species can sometimes be found flowering after burning but also flowers normally in

absence of fire (personal observation).

Discussion - Berg (1857) gives the type of *E. complicata* as: 'Habitat ad Chapada in prov. Minarum, floret Majo: Gardner 5162'. This number is a Lauraceae from Serra do Frio; the Gardner n. 4162 collection at Kew, however, is Myrtaceous, matches the description and is anotated in Gardner's hand as 'Goyaz, Chapada N. S. d'Abadia, May 1840'. I therefore believe that the number 5162 was a printing error; the Chapada da Abadia is very near the Minas Gerais-Goiás border.

This species was frequently identified by Legrand as *Eugenia angustana* Kiaersk., apparently a mispelling of *Eugenia augustana* Kiaersk.; this species, whose type I have examined, bears a slight resemblance to *E. complicata* but is definitely distinct.

5. ***Eugenia cristaensis*** Berg, *Fl. Bras.* 14(1): 222. 1857. Tab. 4 fig. 75. Type. Brazil. Goiás: 'In montibus Serra dos Cristaes' *Pohl* 5751 (Holotype W n. v.) **(Fig. 3.12)**

Syn.: *E. paranahybensis* Berg, *Fl. Bras.* 14(1) *Supl.:* 587. 1859. **nov. syn.** Type. Brazil. Minas Gerais: Inter Rio das Velhas et Paranahyba, *Riedel* 2457 (Holotype LE? n. v., Isotype K!)

? *E. parvula* Glaziou, *Mem. Soc. Bot. France* 3: 228. 1908. nom. nud. **nov. syn.** Original collection. Brazil. Minas Gerais: 'Curalinho, prés Diamantina, dans le camp aride' *Glaziou* 19358 (Original collection P? n. v.)

E. pichoana Glaziou, *Mem. Soc. Bot. France* 3: 228. 1908. nom. nud. **nov. syn.** Original collection. Brazil. Goiás: Pichoá, dans le campo aride (fide Glaziou 1908), Nov 1896, *Glaziou* 21141 (Original collection P? n. v., Isotype K!)

Shrub 0.3-0.8 m. **Hairs** very fine, white with a pinkish or salmon tint when dense; new growth, vegetative buds, bracts and ovary densely sericeo-velutinous to weakly pubescent; sepals sericeo-puberulous within; twigs, petioles, leaves and pedicels pubescent to glabrous; petals, staminal disk, androecium, gymnoecium and mature fruit glabrous. Mature **leaves** 0.8-7 x 0.1-2.1 cm, 2.6-14 times as long as wide, linear-lanceolate, lanceolate or slightly oblanceolate to ovate; petiole 1-4 x 0.75-1.5 mm. **Flowers** solitary, axillary, sometimes appearing terminal due to extreme reduction of the distal nodes, or in 2-7 flowered

racemes; racemes apical or axillary, 1.8-3 cm, sometimes with 1-2 pairs of barren bracts on the basal portion and usually ending in 2 flowers; peduncle 1-10 mm; bracts and bracteoles mostly persistent in the fruit, 1-2 mm, ciliate, glandular, the bracts lanceolate, the bracteoles linear to navicular, connate at base in the young bud, splitting apart as the bud matures; pedicels 3-15 x 0.25-0.5 mm; mature buds 3-6 x 2-2.75 mm, obovate; anthesis occurs as the 4 sepals and petals open. Calyx lobes in 2 subequal to unequal pairs, imbricate, the outer pair deltoid, obtuse to sharpely acute, the inner pair narrower at base, oblong to obverse-elliptic, rounded, 0.5-2.5 x 2-3 mm, wide-rounded or obtuse, ciliate; hypanthium not prolonged above stylar insertion. Petals white or pinkish, 3-5.5 mm, wide-elliptic to roundish, ciliate, glandular. Staminal disk 2-2.75 mm across, flat, squarish to circular; stamens 60-89, in 3-4 irregular whorls, 3-6 mm; anthers 0.5-0.75 mm, roundish to oblong, with a noticeable apical gland. Style incurved in bud, later c. 4-5 mm; ovary 1.25-1.5 mm, bilocular; ovules 12-19, 5-10 per loculus; stigma truncate. **Berry** maturing yellow, orange and finally (?) red, 12-15 mm long, roundish, crowned by the incurved or somewhat flaring calyx lobes; pericarp thin; seeds 1(-2), c. 6 mm, reniform to almost C-shaped; testa silky-white dorsaly, light brown around the hilum, slightly sculptured, pergaminaceous, with several rows of dark glandular dots when imature; embryo eugenioide.

Examined material - **Brazil. Distrito Federal:** Brasília, Plano Piloto, 15 Jan 1967, *Heringer* 11627 (UB); Horto do Guará, 20 Oct 1961, *Heringer* 8876 (UB); Sobradinho, 8 Aug 1964, *Heringer* 9742 (UB); Reserva Ecológica do IBGE, 1100 m, 25 Nov 1986, *Proença* 656 (HEPH); Jardim Botânico de Brasília, 9 Oct 1988, *Proença* 695A (HEPH); ibid., *Proença* 695B (HEPH); ibid., *Proença* 695C (HEPH); ibid., *Proença* 695D (HEPH); Reserva Ecológica do IBGE, 18 Dec 1986, *Silva & Alvarenga* 239 (IBGE); Campus da Universidade de Brasília, 16 Nov 1977, *Taxonomy Class of Universidade de Brasília* 557 (UB); **Goiás:** Pichoá, dans le campo aride (fide Glaziou 1908), Nov 1896, *Glaziou* 21141 (K); Chapada dos Viadeiros, 21 Dec 1968, *Harley & Barroso* 11463 (K); C. 35 km S of Caiapônia on road to Jataí, 900 m, 28 Oct 1964, *Irwin & Soderstrom* 7509 (UEC); Pirenópolis, 7 Dec 1987, *Morellato & Carvalho* 19916 (UEC); **Minas Gerais:** Inter Rio das Velhas et Paranahyba, *Riedel* 2457 (K); **Mato Grosso:** Burity, Sep 1927, *Colenette* 179 (K); Burity, Jun 1927, *Smith* 333 (K); **Mato Grosso do Sul:** Cuiabá, 165 m, 30 Sep 1978, *Macedo & Duarte* 988 (UEC); Cuiabá, Km 14 da Rodovia MT 305, 18 Sep 1984, *Oliveira Filho* 179 (UEC); ibid., 13 Oct 1984, *Oliveira Filho* 193

(UEC).

Distribution - Restricted to the highlands of the cerrados region in Western Minas Gerais, Goiás and Mato Grosso within a relatively narrow latitudinal belt.

Discussion - Although I have not seen the type of *E. cristaensis,* the excellent illustration ('nature' lithograph of an actual leaf) and description in *Flora Brasiliensis* (Berg 1857) permit identification of the species. It is a very polymorphic taxon, especially in the size and length/width ratio of the leaves, inflorescence structure and pubescence. In the Distrito Federal material the young leaves, pedicels, bracteoles and ovaries seem to be always densely pubescent but in the drier extremes of distribution, such as Mato Grosso do Sul, Chapada dos Veadeiros and Northern Minas Gerais, glabrous or nearly glabrous plants can sometimes be found. The type of *E. paranahybensis* belongs to this group.

Three collections from the vicinity of Cuiabá (Oliveira Filho n. 179 &193, Macedo n. 988) with completely glabrous leaves, delicate, lax racemes and very small flowers are tentatively referred to this species. It also occurs in that locality in its more typical form as is testified by the Colenette n. 179 and Smith n. 333 collections. These latter two collections were matched to the original collection of a Glaziou *nomen nudum, E. parvula,* so that name is included as a possible synonym. It comes soon after *E. pichoana* in Glaziou's published collections *Liste* (1908), so I think it likely that the same species is involved.

6. ***Eugenia dysenterica*** Mart. ex DC., *Prodromus* 3: 268. 1828. Type. Brazil. Goiás: 'provincia centralis vis campis siccis altis' *Martius* s. n. (Holotype M!) **(Figs. 3.13 & 4.1 d)**

Syn.: *Stenocalyx dysentericus* (Mart. ex DC.) Berg, Fl. Bras. 14(1): 351. 1857. Based on *Eugenia dysenterica.*

Tree or large shrub, 2.5-8 m, glabrous. Bark of trunk dark silvery-grey, deeply fissured in a grid-like pattern, detaching in oblong, corky chunks, burgundy-brown underneath. Old branches quadrangular, flaking. Young leaves appearing and developing with the flower buds, at first brown to reddish violet and then very pale yellow-green, drying hyaline. Mature **leaves** 3-8.5 x

1.5-5.3 cm, 1.7-2.4 times as long as wide, ovate to elliptic; apex barely acuminate with with an abrupt, thick, rounded or somewhat emarginate acumen; base barely acute, obtuse, rounded or subcordate, frequently disequal; petiole 2.5-6 x 1-1.5 mm. Precocious raceme apical to lateral, 2.5-8 cm (including young leaves), with (1-)2-6 **flowers**; peduncle 0-2 mm; bracts persistent during flowering, 3-6 mm, ovate to narrow-oblong, ciliate; bracteoles deciduous in very young bud, 0.5-2 mm, rounded, hyaline, densely ciliate; pedicels 7-30 x 0.5 mm; mature buds 5-7 x 3.5-4.5 mm, narrowly obovate; anthesis occurs as the 4 sepals open. Calyx lobes equal, 2.5-5 x 2.5-3 mm, ovate to deltoid, acute to rounded, with a few scattered glands, slightly ciliate with a tuft of burgundy coloured hairs at apex; hypanthium not prolonged above stylar insertion. Petals white 5-11 mm, obovate to elliptic, slightly ciliate. Staminal disk 2.5-4 mm across, flat, square, stamens c. 59-72 in 3-4 irregular whorls, 4.5-9 mm; anthers 0.5 mm, roundish to elliptic. Style 5-8 mm, the tip only slightly incurved in bud; stigma truncate; ovary 1-2 mm; locules 2; ovules on a central placenta, 4-8, 2-4 per loculus. **Berry** yellow-green to lemon yellow, 18-30 mm, somewhat oblate to roundish, crowned by the dry, incurved calyx lobes; epicarp dull, membranaceous; pericarp very juicy; seeds 1-4, 12-16 mm, elliptic but plano-convex or faceted if seeds are 2 or more, with a rather sharp ridge running along the dorsal side and ending with a galiform protuberance near the hilum; testa yellowish cream, dull, somewhat sculptured, crustaceous; embryo cream, eugenioide.

Examined material - **Brazil. Distrito Federal:** Estação Florestal Cabeça do Veado, 1050 m, 25 Apr 1983, *Alves* 189 (HEPH); ibid., 9 Sep 1983, *Alves* 196 (HEPH); Fazenda Agua Limpa, 1100 m, 3 Sep 1980, *Bernd* 7 (UB); Campus da Universidade de Brasília, 16 Aug 1978, *Filgueiras* 354 (UB); 8 Mar, *Haridasan & Rocha* 322 (UB); Fazenda Agua Limpa, 23 Apr 1984, *Haridasan* 457 (UB); Campus da Universidade de Brasília, 20 Jul 1973, *Heringer* 12840 (UB); ibid., *Heringer* 12841 (UB); Bacia do Rio São Bartolomeu, 15 Jul 1980, *Heringer & Filgueiras* 5243 (IBGE); Brasília, near Science Center of University, 14 Aug 1964, *Irwin & Soderstrom* 5111 (UB); Unversidade de Brasília, 2 Sep 1964, *Irwin & Soderstrom* 5860 (UB); 30 km E of Brasília on road to Planaltina, 13 Sep 1964, *Irwin & Soderstrom* 6214 (UB); Chapada da Contagem, 1000 m, 25 Aug 1965, *Irwin & Souza* 7879 (UB, UEC); Planaltina, 950 m, 29 Sep 1965, *Irwin & Souza* 8811 (UB); Rio Preto, 10 Sep 1972, *Lordelo* 27 (HEPH); Fundação Zoobotânica, 30 Apr 1963, *Pires & Silva* 9573 (UB); Escola Fazendária, 29 Aug 1976, *Ratter* 3508 (E, UB, UEC); Estação Florestal Cabeça do Veado, 1100 m, 26

Sep 1983, *Reis* 129 (HEPH); Reserva Ecológica do IBGE, 18 Sep 1986, *Rocha & Dias* 15 (IBGE, UB); Campus da Universidade de Brasília, 28 Jul 1965, *Sucre* 770 (UB); **Goiás:** Padre Bernardo, 6 Apr 1983, *Haridasan & Araújo* 164 (UB); Fazenda Farias, 9 Sep 1984, *Mendonça & Dalmácio* 359 (IBGE); Padre Bernardo, 19 Sep 1972, *Ratter & Fonsêca* 2424 (E); **Minas Gerais:** Gouveia, 13 Sep 1985, *Hatschbach & Zelma* 49604 (UEC); Januária, 27 Aug 1990, *Mendonça & Bensusan* 1598 (IBGE); Januária, 27 Aug 1990, *Mendonça & Bensusan* 1611 (IBGE); Esmeraldas, 4 Sep 1979, *Rocha* 10372 (UEC); **Mato Grosso do Sul:** Salgadeira, Chapada dos Guimarães, 26 Jun 1983, *Oliveira Filho* 120 (UEC); **Mato Grosso:** 270 km N of Xavantina, 1 Oct 1968, *Harley & Souza* 10392 (E); 270 km N of Xavantina, 11 Jul 1968, *Ratter & Castro* 2144 (E); **Bahia:** Formosa do Rio Preto, 13 Oct 1989, *Silva & Dias* 77 (IBGE).

Vernacular names - Cagaita, Cagaito, Cagaiteira (Distrito Federal, Goiás, Minas Gerais, São Paulo). A locally well-known species due to the tart, aromatic fruit, it can be associated to extremely poor soils (Silva Jr. 1983). The tree matures its fruit crop more or less simultaneously, thus making the gathering well worthwhile: beverages and jams are sometimes prepared with the fruits by local people when it is in season. The vernacular name refers to a putative laxative effect if too many fruits are eaten, but most people can partake normally of them without suffering any adverse effects.

Distribution - In the Distrito Federal, Goias, Mato Grosso and western part of São Paulo, Minas Gerais and Bahia. The paratype is a sterile Martius collection of leaves supposedly from Ypanema in São Paulo, but I suspect an error in locality since this area is relatively well-known and it has not been collected there since.

Discussion - This is a very distinctive species, unlikely to be confused with any other.

7. ***Eugenia florida*** DC., *Prodromus* 3: 283. 1828. Type. Brazil. Amazonas: Pr(oviíncia) do Alto Amazonas, ad flumen Amazon, *Martius* s. n. (Holotype M!) **(Fig. 3.14)**

Syn.: *E. atropunctata* Steudel, *Fl. Ratisb.* 26(45): 762. 1843. Type. Suriname: *Hostmann* 1108 (Holotype n. v., Isotype K!)

E. gardneriana Berg, Fl. Bras. 14(1): 316. 1857. Type. Brazil. Ceará: Near Crato, Sep 1838, *Gardner* 1615 (Holotype W n. v., Isotype F! K!)

E. gardneriana var. *depauperata* Berg, *Fl. Bras.* 14(1): 316. 1857. Type. Brazil. Pernambuco: Nov 1837, *Gardner* 1017 (Holotype W n. v., Isotypes E! F! K!)

E. gardneriana var. *dives* Berg, *Fl. Bras.* 14(1): 316. 1857. nom. illeg. to be substituted by *E. gardneriana* var. *gardneriana.* Type. Brazil. Ceará: Near Crato, Sep 1838, *Gardner* 1615 (Lectotype W? n. v., Isotypes F! K!)

E. oligoneura Berg, *Fl. Bras.* 14(1): 321. 1857. Type. Peru. Loreto: 'in silvis ad Muniches in Maynas, floret Martio' *Pöppig* 2353 (Holotype B - destroyed, W? n. v.)

E. gardneriana var. *ovata* Berg, *Fl. Bras.* 14(1) Supl.: 589. 1859. Type. Brazil. São Paulo: Rio de Paraná, in silvis umbrosis, florebat Augusto, *Riedel* s. n. (Holotype LE? n. v., Probable Isotype F!)

E. membranacea Berg, *Fl. Bras.* 14(1) *Supl.* : 589. 1859. **nov. syn.** Type. Brazil. Bahia: Prope Castelnovo, Oct 1821, *Riedel* 523 (Holotype LE n. v., Isotype K!)

E. seriato-racemosa Kiaersk., *Symb. Fl. Bras. Centr.* 39: 151. Tab. 21 fig. d. 1893. **nov. syn.** Type. Brazil. Minas Gerais: Lagoa Santa, in sylvis, 23 Jan 1863, *Warming* s. n. 24 (Holotype C!)

Tree or large shrub 2-20 m, predominantly glabrescent or appearing so. **Hairs** rufous or colourless; young branches, vegetative buds, calyx lobes within and sometimes leaf veins above minutely rufo-sericeous; inflorescence axis, bracts and sometimes bracteoles hispidulous with short, sparse hairs. Bark of trunk smooth, flaking irregularly, internally pinkish-brown, c. 1 cm thick, silky-textured; wood very pale straw coloured. Mature **leaves** 1.2-12.5 x 1-5.7 cm, 1.6-5.9 times as long as wide, ovate or elliptic, varying widely in shape and size in one individual, the distal ones usually larger and narrower; apex barely acuminate to strongly so, the tip blunt to fine; base rounded, obtuse or acute, decurrent on the petiole; petiole 6-11.5 x 1-1.75 mm. Raceme axillary or supra-axillary, rarely compounded into a panicle at the lower axils, usually ending in a pair of flowers flanking a minute, abortive vegetative bud, 1.5-6 cm; peduncle 3-18 mm; **flowers** 3-10(-30 in panicles); bracts mostly falling after anthesis, deltoid, acute; bracteoles mostly persistent in the fruit, 0.75-1.25 mm, semicircular to ovate, obtuse or acute, slightly ciliate in bud; pedicels 1.25-9.5 x 0.25-1 mm; mature buds 3-5.25 x 3-4 mm, pear-shaped to capitate; anthesis occurs by the 4 sepals and petals open. Calyx lobes in 2 unequal pairs, 1.25-2 x 1.5-2.25 mm, rounded, glandular, densely rufous-ciliate to slightly so, the outer

pair smaller, semi-circular to transverse-elliptic, the inner pair slightly larger, ovate to oblong; hypanthium not prolonged above stylar insertion. Petals white, 3.5-6 mm, obovate to circular, glandular, ciliate. Staminal disk 2-3 mm across, flat, square, stamens c. 43-53 in 2-3 irregular whorls, 2.5-5 mm; anthers 0.5-1 mm, oblong to elliptic, with an inconspicuous apical gland. Style 3.5-7 mm, erect or bent at the tip in bud; stigma truncate; ovary 0.75-2 mm; locules 2; ovules 8-9, 4-5 per loculus, arranged on one plane from a central placenta. **Berry** reddish to purplish black, 9-11 mm long, roundish to slightly elongated, crowned by the incurved calyx lobes; pericarp thin; seeds 1-2, 7-8 mm, almost round except for slight depression at hilum; testa light brown, papiraceous; embryo eugenioide, sometimes with a short false inter-cotyledonary line.

Examined material - **Brazil. Distrito Federal:** Chácara na beira do Rio São Bartolomeu, 23 Apr 1979, *Heringer & Paula* 1220 (IBGE); Bacia do Rio São Bartolomeu, 11 Jul 1979, *Heringer & Filgueiras* 1796 (IBGE); ibid., 22 Oct 1979, *Heringer & Filgueiras* 2574 (IBGE); ibid., 29 Apr 1980, *Heringer & Filgueiras* 4538 (IBGE); ibid., 7 May 1980, *Heringer & Filgueiras* 4658 (IBGE); ibid.,, 12 Jun 1980, *Heringer & Filgueiras* 5083 (IBGE); ibid., 9 Jul 1980, *Heringer & Filgueiras* 5223 (IBGE); ibid., 22 Sep 1980, *Heringer & Filgueiras* 5463 (IBGE); ibid., 5 Aug 1981, *Heringer & Filgueiras* 7324 (IBGE); Brasília, 5 Oct 1962, *Heringer* 9038 (HEPH, UB); Sobradinho, 20 Jul 1963, *Heringer* 9261 (UB); Chapada da Contagem, c. 10 km E of Brasília, 1000 m, 14 Sep 1965, *Irwin & Souza* 8285 (UEC, UB); Sobradinho, 1100 m, 27 Sep 1965, *Irwin & Souza* 8736 (UB); Immediately W of Planaltina, 950 m, 28 Sep 1965, *Irwin & Souza* 8747 (UB); Beira do Rio São Bartolomeu, *Pereira & Filgueiras* 1279 (IBGE, UB); Córrego Taquara, 29 Aug 1990, *Pereira* 1426 (IBGE); Cachoeira do Pipiripau, 30 Jun 1982, *Pereira* 304 (IBGE); Barragem de Saia Velha, 29 Apr 1983, *Pereira* 490 (IBGE); **Minas Gerais:** Uberlândia, Fazenda do Glória, 23 Sep 1989, *Araújo* s. n. (Uberlândia); Uberlândia, Fazenda do Panga, 28 Sep 1989, *Araújo* 93 (Uberlândia); Timóteo, Parque Estadual do Rio Doce, 22 Oct 1982, *Heringer* 18545 (IBGE); Januária, 31 Aug 1990, *Mendonça & Silva* 1629 (IBGE); Reserva do Grande Sertão Veredas, 6 Nov 1990, *Ratter & Silva* 6379 (IBGE); Lagoa Santa, in sylvis, 23 Jan 1863, *Warming* s. n. (C); *Unknown* s. n. (K); **São Paulo:** Cajurú, 19 Nov 1986, *Bernacci* 323 (UEC); Porto Ferreira, Parque Estadual de Porto Ferreira, 3 Sep 1980, *Bertoni* 11469 (E, UEC); ibid., 2 Dec 1981, *Bertoni* 20409 (UEC); Eldorado to Sete Barras, 50 m, 10 Sep 1976, *Davis & Shepherd* 60868 (E); Rio de Paraná, in silvis umbrosis, florebat Augusto, *Riedel* s. n. (F); **Mato**

Grosso: 270 km N of Xavantina, 16 Oct 1968, *Castro* 10668 (E); 240 km N of (Nova) Xavantina, 7 May 1968, *Ratter & Santos* 1337 (E); 1.5 km E of Xavantina, 500 m, 30 Aug 1967, *Richards & Argent* 554 (E); C. 270 km N of Xavantina, 19 Aug 1968, *Richards & Argent* 6722 (E); C. 20 km N of Base Camp (12o 49' S, 51o 46' W), 21 Aug 1968, *Richards & Argent* 6772 (E); 290 km N of Xavantina, 12 Jun 1968, *Santos & Souza* 1746 (E); Poconé, 25 Oct 1985,*Thomas & Cid* 4571 (K); **Pará:** Obidos, 10 Jan 1905, Ducke 6956 (MG); Marabá, Serra dos Carajás (Serra Norte), 21 Apr 1970, *Silva* 2664 (MG); **Pernambuco:** Nov 1837, *Gardner* 1017 (E, F, K); **Ceará:** Near Crato, Sep 1838, *Gardner* 1615 (F, K); Probably **Piauí:** *Gardner* 2612 (F); **Amazonas:** Pr(ovíncia) do Alto Amazonas, *Martius* s. n. (M); Pr(ovíncia) do Alto Amazonas, ad flumen Amazon, *Martius* s. n. (M); **Goiás:** Luziânia, 15 Oct 1986, *Mendonça & Alvarenga* 768 (IBGE); Goiás Velho, 7 Nov 1976, *Ratter & Fonsêca Filho* 3952 (E); Cristalina, 10 Nov 1978, *Roberto* s. n. (UEC); **Roraima:** Reserva Ecológica da Ilha de Maracá, 11 Jul 1987, *Milliken & Bowles* 438 (K); **Bahia:** Prope Castelnovo, Oct 1821, *Riedel* 523 (K). **Guyana. Essequibo:** Aga Creek, upper Mazaruni River, 8 Jul 1957, *Butt & Boyan* 32 (K); Essequibo, Barima River, oposite Anabisi Creek, 8 Apr 1945, *Forest Department of British Guiana* 2461 (K). **Bolivia. Pando:** W bank of Rio Madeira, 3 km. above Abuña, 13 Nov 1968, *Prance & Rodrigues* 8375 (MG). **Paraguay. Cordillera:** Cordillera de Altos, 6 Nov 1902, *Fiebrig* 379 (E). **Suriname. Nickerie:** Wilhelmina Gebergte, 3 km above confluence of Zuid River with Lucie River, 250 m, 20 Sep 1963, *Irwin & Prance* 55908 (K); **Locality unknown:** Mapanekreek, Jodensavanne, 2 Nov 1967, *Forestry Service* 11188 (K).

Vernacular names - Gumirim (Distrito Federal); Cafezinho-da-mata (Mato Grosso); Guamirim (Santa Catarina, Legrand 1969); Pitanga (Paraná, Legrand 1969); Rupinia (Peru, McVaugh1958). The flowers are very fragrant and the tree is intensely visited by bees during flowering and by birds when in fruit.

Distribution - A widely distributed taxon, occurring from Southern Brazil to Central America (Map), frequently along waterways. In the Distrito Federal it grows in gallery forests, mesophytic forests and calcareous forests; this species ranked first in Importance Value in the latter kind of forest (Ramos 1989). It also frequently occurs as a rheophyte and has also been found in a temporarily flooded 'cambarazal' in Mato Grosso do Sul (Nascimento & Cunha 1989), which suggests it is probably quite a flood-tolerant species.

Discussion - *E. gardneriana,* and its varieties, are typical of the more southerly individuals of this species. Legrand (1977), although commenting upon their similarity, chose to recognize three closely related species in this complex: *E. gardneriana* in the Southern Brazilian States, *E. moraviana/paracatuana* in Western Minas Gerais, Goiás and Mato Grosso and *E. florida* in the Amazon. I concur with McVaugh (1958) in considering *E. gardneriana* (and another of Berg's species, *E. oligoneura*) as mere forms of *E. florida.* As for *E. moraviana,* this I believe is a closely allied but distinct species. *E. membranacea* is based upon a flowering individual with very young leaves, a somewhat rare condition in the species but which does occur, while in the type of *E. seriato-racemosa* the racemes are compounded so that the inflorescence is a panicle. Neither condition merits taxonomic recognition.

8. ? ***Eugenia glandulosa*** Camb. 1833. Type. Brazil. Minas Gerais: 'In pascuis prope Candonga' *Laroutte* s. n. (Holotype P? n. v.) (**Fig. 3.15 & 4.2 g**)

Syn.: ? *Phyllocalyx edulis* Berg, *Fl. Bras.* 14(1): 327, Tab. 5 fig. 90, Tab. 29. 1857.

?*Eugenia edulis* (Berg) Kiaersk., 1893. non Vell., non Benth. & Hook. nom. illeg. Based on *Phyllocalyx edulis.*

?*Phyllocalyx glandulosus* (Camb.) Legr., *Notulae Systematicae* 15(1):270. 1954.

Shrub to 1.5 m, spreading over a radius of c. 3 m through an underground root system. **Hairs** white with pinkish tint, very short; new growth and calyx lobes and bracteoles inside sericeo-puberulent, the rest of the fruiting plant glabrous. Mature leaves 2.2-8.5 x 0.9-2.7 cm, 2.3-4.2 times as long as wide, elliptic or slightly obovate; apex acute or less frequently obtuse or acuminate, the extreme tip rounded; base cuneate, acute or barely obtuse; petiole 2.5-5 x 0.75-1.5 mm. **Flowering** specimens not seen but the inflorescence probably consisting of solitary, axillary flowers or an apical, 2-5 flowered precocious raceme; bracts not seen; bracteoles persistent in the fruit, 2.5-6.5 mm, ovate to subcordate, obtuse to acute, glandular; pedicels 14-30 x 1.25 mm; anthesis occurs as the 4 sepals open. Calyx lobes subequal, 5-9 mm, elliptic or oblong, rounded, with large glandular dots, ciliate; hypanthium probably not prolonged above stylar insertion. **Berry** bright yellow, 30-45 mm long, roundish but rather attenuate at both ends and irregularly sulcate, crowned by the upright green calyx lobes; epicarp thin, shiny; pericarp juicy; seed 1, c. 12-16 mm, roundish to elliptic with

a rounded ridge running along the dorsal side and ending in a galiform protuberance near the hilum; testa yellow-ochre, slightly rugose, crustaceous; embryo cream, plinioide.

Examined material - **Brazil. Distrito Federal:** Jardim Botânico de Brasília, 1100 m, 7 Nov 1988, *Proença* 700 (HEPH).

Distribution - Uncertain; the specimen seen was collected in dense, shady cerrado bordering on mesophytic forest.

Discussion - The application of this name is tentative, being based only upon the comparison of a single fruiting specimen with the description of the flowering type. Legrand (1954) saw the type and transferred this species to *Phyllocalyx* (a genus he was later to unite with *Eugenia*) and published an extended diagnosis, noting that the protologue was insufficient to destinguish the species. Two Berg names match equally well and may prove conspecific or even substitute this name if the type specimen of *E. glandulosa* should prove to belong to another species: *Phyllocalyx edulis* and *P. racemosus*. The type of *P. edulis* is apparently from restinga vegetation in Rio de Janeiro. It was transferred to *Eugenia* as *E. edulis* by Kiaerskov but this is a later homonym of *E. edulis* Vell., so if it is to be used a new name should be instated. The description of the fruits, given by Beyrich, matches this specimen very well. The type of *P. racemosus* was collected somewhere in São Paulo by Sellow - the bracteoles seem to be rather larger than in this species and the raceme is said to have 'less than 20 flowers'. A final decision depends upon further collections and examination of type material.

9. ***Eugenia klotzschiana*** Berg, *Fl. Bras.* 14(1): 255. 1857. Type. Brazil. Minas Gerais: 'in campis ad Arco das Rivas' *Sellow* s. n. (Syntype B - destroyed, Isotype K!); 'Prope S. João del Rey' *Widgren* 528 (Syntype MEL n. v., Isotype S!) **(Fig. 3.16 & 4.1 c)**

Syn.: *Eugenia klotzschiana* var. *glabrata* Berg, *Fl. Bras.* 14(1) *Supl.* : 572. 1859. Type. Brazil. Minas Gerais: Prope Curvellos, Nov 1834, *Riedel* 2578 (Holotype LE n.v., Isotype F!)

Shrub c. 0.5-1 m, the young parts predominantly velutinous. Hairs whitish to

pale grey with a pinkish tint, rather long; branches pubescent; young leaves, petioles, ovaries, calyx lobes, petals without and fruit velutinous; petioles and leaves sparsely pubescent to glabrous at maturity; petals within, androecium and gynoecium glabrous. Mature **leaves** 5-15.5 x 2.4-7.7 cm, 1.6-2.9 times as long as wide; petiole 4-9 x 1.75-3.5 mm. **Flowers** 1-4 in the leaf axils or in a precocious, apical raceme 5-7 cm; peduncle 0-4 mm; bracts c. 2-5 mm, at base of pedicels; bracteoles usually deciduous at anthesis or persisting until fruit initiation, 2.5-5 mm, linear; pedicels 8-32 x 1-2.5(2-3.5 in fruit) mm; mature buds 6-16 x 7-10 mm, pear-shaped; anthesis occurs as the 4 sepals open with slight tearing at the sinuses. Calyx lobes slightly unequal, 4.5-10 mm, suborbicular to ovate, acuminate, ciliate; hypanthium slightly prolonged above stylar insertion in bud. Petals 8-18 mm, slightly obovate to suborbicular, densely ciliate. Staminal disk 5-6 mm across, flat, square, stamens c. 241-271 in c. 4 irregular whorls, 6-14 mm, the outer whorls erect and the inner whorls incurved in bud; anthers 0.75-1.5 mm, roundish to elliptic, with no apical gland. Style 9-12 mm, bent at apex in bud; stigma truncate to slightly expanded; ovary 2-4.75 mm; locules 2 to 4; ovules on a v-shaped central placenta, c. 85-96, c. 13-28 per loculus; funiculus rather long. **Berry** light yellow, 80-85 mm long, pear-shaped, crowned by the initially reflexed, finally upright and somewhat diverging calyx lobes; pericarp thick, fleshy; seeds 1-3, 17 mm, roundish; testa cream, very slightly sculptured; embryo plano-convex.

Examined material - **Brazil. Distrito Federal:** Reserva Ecológica do IBGE, 23 Jan 1990, *Alvarenga* 633 (IBGE); Reserva do Jardim Botânico de Brasília, 1100 m, 10 Dec 1986, *Equipe do Jardim Botânico de Brasília* 796 (HEPH); (Reserva do Jardim Botânico de Brasília) Próximo à Cabeça do Veado, 20 Dec 1981, *Filgueiras & Pereira* 946 (IBGE, UEC); Sede do IBDF (Instituto Brasileiro de Desenvolvimento Florestal), 17 Dec 1985, *França* s. n. (UB); Parque Nacional de Brasília, 5 Sep 1974, *Heringer & Ehrenberger* 13937 (UB, UEC); Parque do Guará, 16 Apr 1975, *Heringer* 14553 (UB, UEC); Fundação Zoobotânica, 30 Jan 1963, *Heringer* 9098 (HEPH, UB); Entre Brasília e Sobradinho, 18 Sep 1964, *Heringer* 9646 (UB); 15 km SW of Brasília on road to Goiânia, 1250 m, 24 Sep 1965, *Irwin & Souza* 8631 (UB); Fazenda Agua Limpa, Nov 1984, *Maria Theresa* s. n. (UB); Reserva Ecológica do IBGE, 24 Sep 1984, *Pereira* 1195 (IBGE); Fazenda Agua Limpa, 24 Nov 1976, *Ratter & Fonsêca Filho* 3984 (E, UB); **Goiás:** 1896, *Glaziou* 21199 (K); **São Paulo:** Itirapina, 3 Sep 1980, *Giannotti* 12317 (UEC); **Minas Gerais:** Caldas, 1846, Regnell 3-571 (K); Prope Curvellos, Nov 1834,

Riedel 2578 (K); Arco das Rivas, Sep 18??, *Sellow* s. n. (K); Prope S. João del Rey, 1845, *Widgren* 528 (S).

Vernacular names - Pera-do-Cerrado, Cabaça (Distrito Federal), Cabacinha do Campo (Minas Gerais). The downy, yellow pear-shaped fruits are among the largest of the genus and are attractive and aromatic, but have a bitter-acid taste like a grapefruit.

Distribution - A species which is apparently restricted to the cooler parts of the cerrados region, i. e., the Distrito Federal, southern Goiás, Minas Gerais and São Paulo.

Discussion - A very distinctive species, unlikely to be confused with any other. There are no grounds for maintaining var. *glabrata,* as in most plants the leaves seem to lose their dense pubescence with age.

10. ***Eugenia lutescens*** Camb., *Florae Brasiliensis Meridionalis* 2: 341. 1833. Type. Brazil. Minas Gerais: 'Prope Bom Jardim. Florebat Septembri' *Saint Hilaire* s. n. (Holotype P?) (**Figs. 3.17, 4.1 b & 4.2 d**)

Syn.: *Eugenia itajurensis* Camb., *Florae Brasiliensis Meridionalis* 2: 340. 1833. Type. Brazil. Minas Gerais: 'Itajurú de São Miguel do Mato Dentro. Lecta cum floribus fructibusque maturis Februario' *Saint Hilaire* s. n. (Holotype P? n. v.)

Eugenia ternatifolia Camb., *Florae Brasiliensis Meridionalis* 2: 336, Tab. 150. 1833. Type. Brazil. Goiás: 'Serra Dourada et Gorgulho. Florebat Julio'*Saint Hilaire* s. n. (Holotype P? n. v.)

Eugenia stephani Berg, *Fl. Bras.* 14(1):242. 1857. Type. Brazil. Minas Gerais: 'Ad Congonhas do Campo' *Stephan* s. n. (Holotype M? n. v.)

? *Eugenia regeliana* Berg, *Fl. Bras.* 14(1) *Supl.:* 573. 1859. **nov. syn.** Type. Brazil. Goiás: 'in Chapada de São Marcos, florebat Augusto' *Riedel* s. n. (Holotype LE n. v.)

Eugenia stephani var. *angustifolia* Berg, *Fl. Bras.* 14(1) *Supl.:* 572. 1859. **nov. syn.** Type. Brazil. São Paulo or Goiás: 'in campis editis graminosi planitiei Chapada de São Marcos florebat Augusto nec non in campis prope Villa Franca et S. Carlos prov. S. Pauli, florebant Junio, Julio' *Riedel* s. n.

(Holotype LE n. v.)

Eugenia stephani var. *latifolia* Berg, *Fl. Bras.* 14(1) *Supl.*: 573. 1859. **nov. syn.** Syntypes. Brazil. São Paulo, Goiás: 'in campis editis graminosi planitiei Chapada de São Marcos florebat Augusto nec non in campis prope Villa Franca et S. Carlos prov. S. Pauli, florebant Junio, Julio' *Riedel* s. n. (Holotype LE n. v.)

Myrtus tomentosus Glaziou non Aubl., *Mem. Soc. Bot. France* 3: 209. 1908. nom. nud. **nov. syn.** Type. Brazil. Goiás: Campo do Brejo, *Glaziou* 21178. (Original collection P n.v., K!)

Shrub or hemixyle, 0.3-1 m, more or less pubescent. **Hairs** white with pinkish to yellowish tint. Young leaves and staminal disk velutinous; petioles, leaves, inflorescences, ovary, calyx lobes, petals without and fruits densely pubescent; ovary locules densely albo-sericeous within; style sometimes with sparse hairs at base; petals within and androecium glabrous. Mature **leaves** 0.6-7.2 x 0.4-3.5 cm, 1.4-5 times as long as wide, elliptic, lanceolate or slightly oblanceolate; apex acute or barely acuminate, fine-tipped; petiole 0.5-3 x 0.75-3 mm. **Flowers** solitary, in 3-flowered dichasia or 1-9 flowered raceme which can be compounded of dichasia; raceme apical or lateral, 1.8-2.5 cm; peduncle absent to 10 mm; bracts and bracteoles mostly persistent in the fruit, linear to lanceolate; bracts 1-10 mm; bracteoles 2-6 mm; pedicels 5-26 x 0.5-1.5 mm; mature buds 3.5-9 x 2-7 mm; anthesis occurs as the 4 sepals open. Calyx lobes valvate in the mature bud, in 2 subequal to unequal pairs, 2.5-6 x 2-4 mm, acute, ciliate, the smaller pair reflexed at anthesis, deltoid, the larger pair explanate, deltoid-navicular; hypanthium prolonged 1.5-2 mm above stylar insertion level in bud. Petals 7.5-8 mm, white or slightly pink-tinted, elliptic, ciliate. Staminal disk 3.5-5 mm across, outcurved, square, stamens c. 154-165 in 4-5 irregular whorls, erect in mature bud, 3.5-7 mm; anthers 0.5-1.75 mm, elliptic or oblong with sagitate bases, the apical gland obscure at maturity. Style 4-8 mm, the tip only curved in bud; ovary 2-3 mm; locules 2-3; ovules 11-17, 3-8 per loculus. **Berry** pale yellow to pale orange, 25-50 mm long, roundish, crowned by reflexed calyx lobes; seeds 1-3, 12-14 mm, roundish; testa brown, crustaceous; embryo pinkish cream, plano-convex.

Examined material - **Brazil. Distrito Federal:** Entre Sobradinho e o Centro de Pesquisa Agropecuária do Cerrado, 1200 m, 16 Sep 1982, *Almeida* 526 (UB); Reserva Ecológica do Jardim Botânico de Brasília, 1125 m, 18 Aug 1986, *Equipe*

do Jardim Botânico de Brasília 702 (HEPH); ibid., 4 Oct 1986, *Equipe do Jardim Botânico de Brasília* 752 (HEPH); Horto do Guará, 28 Aug 1961, *Heringer* 8618 (UEC, UB); Parque do Guará, 20 Sep 1962, *Heringer* 8977 (HEPH, UB); Mirante, 8 Aug 1964, *Heringer* 9743(B) (UB); Sobradinho, 8 Sep 1964, *Heringer* 9806 (UB); Fazenda Agua Limpa, *Maria Theresa* s. n. (UB); Reserva Biológica das Aguas Emendadas, 1 Oct 1982, *Oliveira* 122 (IBGE); Reserva Ecológica do IBGE, 7 Nov 1985, *Pereira* 1291 (IBGE, UB); Cabeça do Veado, futuro Jardim Botânico de Brasília, 13 Sep 1984, *Proença* 410 (HEPH, UB); Parque Nacional de Brasília, 2 Oct 1972, *Ratter & Fonsêca* 2530 (UB); Fazenda Agua Limpa, 24 Aug 1976, *Ratter & Fonsêca* 3476 (E, UB); ibid., 1 Nov 1978, *Ratter & Ribeiro* 4251 (E); **Goiás:** *Gardner* 3181 (F); Campo do Brejo, *Glaziou* 21178 (K); **Minas Gerais:** Entre Patrocíneo e Coromandel, 16 Nov 1988, *Felfili & Filgueiras* 87 (IBGE); **São Paulo:** *Riedel* 2499 (K).

Vernacular uses - Produces an excellent tasting pale yellow-orange fruit with a downy texture like a peach. Certain characteristics of fruit, its suculent yet firm texture and thin but slightly tough skin suggest that it could probably resist a certain amount of handling in transport. Other species of *Eugenia* also have attractive, pleasant-tasting vitamin-C rich fruits, but the main obstacle to their large-scale cultivation is their perishability.

Distribution - An endemic cerrados region taxon, apparently restricted to Minas Gerais, the Distrito Federal and Goiás. It grows in most kinds of cerrado *sensu lato,* from campo sujo to cerradão.

Discussion - *Eugenia ternatifolia, E. itajurensis* and *E. lutescens* have equal priority as names for this species. Although *E. ternatifolia* is the only one illustrated and might seem to be the natural choice, I have chosen the latter as it is a well established name for the species, used by Legrand in determinations in many Brazilian Herbaria. The latter two species were compared by Cambessèdes in the protologue and were separated on the basis of leaf size, colour of indumentum and acute as opposed to obtuse flower buds. *E. ternatifolia* was based on a specimen with dichasial inflorescences, a rather uncommon but not unknown condition. In view of modern collections, these differences are insufficient for recognizing three species. I did not see the type of *E. stephanii* Berg, but I have examined Riedel collection no. 2499 anotated as *E. stephanii* var. *genuina* which is probably the material seen by Berg and cited in the

Supplementum to *Flora Brasiliensis* (Berg 1859). The varieties of *E. stephanii* are also unsustainable as with most Berg varieties, being based upon taxonomically insignificant variations in leaf shape. *E. regeliana,* collected from the same locality and compared to the former by Berg is surely conspecific as well: the detail of pauci-ovulate, internally velutinous locules leaves no doubt of this.

The description of the type specimen of *Eugenia sellowiana* DC. is only separable from this taxon by being a tree and having leaves glabrous at maturity, characteristics which I have not observed in *E. lutescens.* Another similar description is that of *Eugenia pohliana* DC. with dichasial inflorescences, such as sometimes occur in *E. lutescens,* but which is said to have rufous hairs. Further collections from Minas Gerais may reveal that either are conspecific, in which case the older De Candolle epithets will prevail.

11. *Eugenia myrcianthes* var. *nana* Legr. *Darwiniana* 5: 481 (1941). Type: Paraguay. Neembucú: Paso de la Patria, *Meyer* 2151 (Holotype MVM? n. v.) (**(Fig. 3.18)**

Syn.: *Hexachlamys humilis* Berg, *Fl. Bras.* 14(1): 380 Tab. 39. 1857. Type. Brazil. Paraná: 'Ad S. Ignacio' *Sellow* s. n. (Holotype B - destroyed)

? *Eugenia langsdorffii* Berg, *Fl. Bras.* 14(1) *Supl.:* 568. 1859. Type. Brazil. São Paulo: 'in campis siccis ad Rio Pardo' *Riedel* s. n. (Holotype LE? n. v.)

? *Eugenia anomala* Legr., *Anal. Mus. Hist. Nat. Montevideo (Ser. 2)* 4(11): 61. 1936. Type. Uruguay. Rivera: Tranqueras, *Arechevaleta* s. n. 'Myrtacaeae 12' (Holotype MVM n. v.)

? *Hexachlamys anomala* (Legr.) Legr., *Darwiniana* 9: 303. 1950. Based on *Eugenia anomala.*

Hemixyle 0.2-0.5 m, predominantly pubescent when young. **Hairs** short, white, with a pinkish tint when dense; young leaves and petioles, pedicels, bracts, sepals, petals without, staminal disk and style base more or less pubescent; ovary and young fruit densely pubescent to velutinous; androecium and petals within glabrous. Xylopodium to 3 cm in diameter. Mature **leaves** 3-12 x 0.3-2 cm, 4-22 times as long as wide, oblanceolate to linear-lanceolate; apex acute, fine-tipped; base acute or cuneate, decurrent on the petiole; petiole 2-4 x 0.75-1 mm. **Flowers** solitary or rarely in 3-flowered dichasia, axillary or at basal,

leafless nodes; bracts to 5 mm, sometimes sub-foliaceous; bracteoles frequently subalternate, mostly persistent in the fruit, 3-9 mm, linear, ciliate; pedicels 8-30 x 0.5-0.75 mm; mature buds 4.5-6.5 x 3-6 mm, obovate-oblong; anthesis occurs as the 4 sepals open. Calyx lobes subequal, 2.5-4 x 2.5-3 mm, oblong, widely ovate or deltoid, subacute to rounded, ciliate; hypanthium very slightly prolonged above stylar insertion in bud. Petals white, 5-6 mm, elliptic or slightly obovate, ciliate. Staminal disk 3.5-4 mm across, flat, square; stamens erect in bud, c. 135-157 in 3 irregular whorls, 3.5-7 mm; anthers 0.75-1 mm, elliptic with a minute, flat apical gland. Style 3.5-7.5 mm, erect in bud; stigma truncate; ovary 2-2.5 mm; locules 2; ovules c. 5-7, 2-4 per loculus. Immature **berry** 15 mm long, roundish, crowned by the reflexed calyx lobes; seeds 1-2, elliptic but plano-convex if seeds are 2 or more; pericarp probably rather thick, fleshy; testa woody; embryo plano-convex.

Examined material - **Brazil. Distrito Federal:** Entre Sobradinho e o Centro de Pesquisa Agropecuária do Cerrado, 1200 m, *Almeida et al.* 367 (IBGE); Fazenda Agua Limpa, *Cesar* 694 (E); Campus da Universidade de Brasília, *Cobra & Oliveira* 2 (UB); Campus da Universidade de Brasília, *Cobra & Oliveira* 8 (UB); Estrada Taguatinga-Braslândia, *Ferreira* 60 (UB); Reserva Biológica das Aguas Emendadas, *Ferreira* 846 (HEPH); Catetinho, *Heringer & Ehrenberger* 13952 (UB, UEC); Horto do Guará, *Heringer* 8742 (UB); Brasília, Plano Piloto, *Heringer* 9008 (HEPH, UB); Campus da Universidade de Brasília, *Inolie* s. n. (UB); C. 15 km E of Lago Paranoá, 1000 m, *Irwin & Fonsêca* 26605 (UB); Chapada da Contagem, 1000 m, *Irwin & Souza* 7937 (UB); Chapada da Contagem, 1000 m, *Irwin & Souza* 7981 (UB); Chapada da Contagem, 1000 m, *Irwin & Souza* 8254 (UB); Vicinity of Planaltina, 950 m, *Irwin & Souza* 8906 (UB); Bacia do Rio São Bartolomeu, *Mendonça* 271 (IBGE); Cachoeira do Pipiripau, *Pereira* 78 (IBGE, UB). Brasília, *Pires & Silva* 9760 (UB); Córrego Cabeça do Veado, *Ratter* 3492 (E, UB); Fazenda Agua Limpa, *Rocha* 5R (E, UB); Caminho para a Sede da Fundação Zoobotânica, *Salles* 359 (HEPH); C. 2 km SW of Barragem do Lago Paranoá, 1100 m, *Webster & Armbuster* 25228 (IBGE); **Minas Gerais:** Patrocíneo, *Mendonça & Walter* 1183 (IBGE); **Mato Grosso:** 6 km S of Xavantina, *Argent & Ramos* 6534 (E); Rio Brilhante, *Hatschbach* 24653 (K, UEC); Tres Lagoas, *Leitão Filho et al.* 12956 (UEC).

Vernacular names - Pessego-do-campo (Santa Catarina, Legrand 1969), Duraznillo-de-campo, Duraznillo silvestre (Uruguay, Legrand 1936).

Distribution - In the southern cerrados region in the Distrito Federal and the States of São Paulo, Mato Grosso do Sul, Goiás and in the rocky campos of western Paraná and Rio Grande do Sul into Rivera in Uruguay, Corrientes, Santa Fé and Chaco in Argentina and in Paraguay (Legrand 1936, 1977). This species grows from sparse campo sujo to cerrado *sensu stricto.* About two-thirds of flowering collections give the habitat as recently burned cerrado, and I have observed many individuals flowering in a cerrado sensu stricto 3-4 weeks after burning. Flowering plants also occur where burning has not taken place, so this species is apparently a facultative pyrophyte in which flowering occurs with sprouting.

Discussion - The oldest names for this taxon at the species rank are *Hexachlamys humilis* and *Myrcianthes edulis,* both published in the *Flora Brasiliensis* by Berg (1857). When Niedenzu transferred *Myrcianthes edulis* Berg to *Eugenia,* he gave it a *nomen novum* as *E. myrcianthes* which is the correct name for this species if *Hexachlamys* is united to *Eugenia.* The genus *Hexachlamys* is based upon *H. humilis,* the type specimen of which is a plant from Paraná with hexamerous flowers. There is certainly a group of species, somewhat intermediate between *Eugenia* and *Myrcianthes,* characterized by 2-3 locules in the ovary, few ovules, pubescent inner locules, hard, thick seed coats and plano-convex embryos. Whether they merit generic segregation is open to question since each segregating character is isolatedly matched in *Eugenia,* although taken in combination a case might be made for the maintenance of *Hexachlamys,* but with the initial distinguishing character of hexamery not being particularly important. Hexamerous or pentamerous flowers occur sporadically in the southern part of the species distribution, sometimes on the same plant as in the type of *E. anomala,* which has tetramerous, pentamerous and hexamerous flowers (Berg 1857, Legrand 1977). There is also a gradual change from the arboreal, wide-leaved forest form usually known as *H. edulis* to the narrow-leaved hemixyle form which occurs in cerrado and is known variously as *H. humilis, Eugenia linearifolia* (a misapplied name which is actually synonymous to *E. punicifolia;* Sobral, 1987) or *E. langsdorffii* (a synonym). In the core cerrados region the hemixyle habit and tetramery of the flowers is apparently fixed (based upon the 28 collections here examined) which in my opinion merits taxonomic recognition at the varietal level only. Since the epithet *humilis* is also exhausted in *Eugenia,* the union of these species brings

about no changes in nomenclature. Although Legrand is the author of *E. myrcianthes* var. *nana* (1941), in a later publication (1968) he accepted *Hexachlamys* and also considered *E. myrcianthes* var. *nana* a pygmy form of *H. edulis* native to Paraguay and Argentina, distinct from *H. humilis* which was said to occur from South-Central Brazil to Northern Uruguay.

12. ***Eugenia piauhiensis*** Berg, *Fl. Bras.* 14(1): 285. 1857. Type. Brazil. Piauí: Near Santo Antonio, 1839, *Gardner* 2169 (Holotype W n. v., Isotype K! F!) **(Fig. 3.19)**

Small **tree** to subshrubby hemixyle, 0.1-3 m. **Hairs** ochraceous, short, wiry and soft; young leaves rather sparingly pubescent; ovary and inner ring surrounding style sometimes sericeo-puberulous; sepals, petals, staminal disk and style glabrous. Mature **leaves** 7-9 x 1.9-3.2 cm, 2.5-3.7 times as long as wide, lanceolate to obovate; apex barely acute to rounded; base acute to cuneate; petiole 4-6.5 x 1-1.25 mm. **Flowers** solitary or in 1-4 flowered umbel-like **racemes**, axillary or at basal, leafless nodes; bracts minute, congested at pedicel bases; bracteoles 0.25-0.5 mm, conate at extreme base, obtuse or rounded, pedicels 1.5-4 x 0.5-0.75 mm; mature buds 5-6 x 4-5 mm, capitate; anthesis occurs as the 4 sepals open. Calyx lobes equal, 0.75-1.25 mm, reflexed in bud, obtuse or rounded, ciliate; hypanthium not prolonged above stylar insertion. Petals imbricate with one completely external one, 3-7 mm in bud, pink, cuculate, noticeably glandular, ciliate. Staminal disk c. 2 mm across, circular, the central ring around the style slightly elevated; stamens c. 127-157 in 3-4 irregular whorls, 3-6 mm; anthers 0.5-1 mm, oblong to elliptic, with minute apical gland. Style 4-7.5 mm, incurved in bud; stigma truncate; ovary c. 1.75 mm; locules 2; ovules 15-22, 7-11 per loculus. **Berry** black, 8-9 mm, roundish; pericarp thin; seed 1, roundish, with a lightly indented, transversal line at the hilum; testa ochre, shiny, pergaminaceous.

Examined material - **Brazil. Distrito Federal:** Estrada Plano-Piloto - Planaltina, *Sales* 376 (HEPH); **Goiás:** São João da Aliança, 30 Oct 1979, *Heringer & Filgueiras* 2667 (IBGE); **Minas Gerais:** Januária, 31 Aug 1990, *Mendonça & Bensusan* 1605 (IBGE); ibid., 28 Aug 1990, *Silva & Bensusan* 162 (IBGE); **Bahia:** Correntina, 18 Oct 1989, *Mendonça & Lopes* 1545 (IBGE); Formosa do Rio Preto, 530 m, 7 Apr 1989, *Scariot & Mendonça* 461 (IBGE); São Desidério, 510 m, 7 Apr 1989, *Scariot & Mendonça* 527 (IBGE); Formosa do Rio

Preto, 530 m, 7 Apr 1989, *Walter & Borgato* 217 (IBGE); **Mato Grosso:** Km 271 of the Xavantina-Cachimbo road, 5 Jan 1968, *Philcox & Ferreira* 3890 (K); **Piauí:** Near Santo Antonio, 1839, *Gardner* 2169 (F, K); **Rio de Janeiro?** 'Near Rio de Janeiro' (probably erroneous) 1878, *Glaziou* 10821 (K).

Distribution - Distributed through the northern cerrados region, perhaps reaching its southern limit in the Distrito Federal; the only Distrito Fedral material to give habitat data cites this as a wet, rocky place. My personal observations, and data from collections North of the Distrito Federal, indicate that the species grows as a shrub on very sandy cerrado, locally called 'Gerais', and as a tree in forest and marsh.

Discussion - A rare species in the Distrito Federal, the only two collections differ from more northernly collections by being very small hemixyles but are otherwise typical of the species. Judging from the description, it is possible that *E. stictopetala* DC., of which I have not seen the type, is an older name for this species. In this difficult group, with several closely allied species, final decisions should not be taken without consulting type material.

13. ***Eugenia piloesis*** Camb., *Florae Brasiliensis Meridionalis* 2: 357. 1833. Type. Brazil. Goiás: 'Prope rivum Rio dos Pilões in parte australi provinciae. Florebat Julio' *St. Hilaire* s. n. (Holotype P? n. v.)

Small **tree** to subshrub 0.3-2.3 m. Mature **leaves** 4-12.5 x 2-5.5 cm, 1.4-3.3 times as long as wide; petiole 3-9 x 1-2 mm. Congested **raceme** with 1-5 **flowers**, axillary or at basal, leafless nodes; bracts minute, clustered at base of raceme; bracteoles mostly persistent in the fruit, 0.75-1.25 mm, pedicels 1.5-8 x. 0.5-1 mm; mature buds 3-6 x 2.25-5 mm; anthesis occurs as the 4 sepals open. Calyx lobes subequal, 0.75-1.5 mm, semicircular, with sparse minute cilia to eciliate; hypanthium not prolonged above stylar insertion. Petals 4.5-5 mm, slightly ciliate to eciliate. Staminal disk 2-3.5 mm across, circular, stamens c. 87-108, crumpled in bud, in c. 3 irregular whorls; anthers 0.75 mm, oblong, with a minute apical gland. Style 6-6.5 mm, curved over the stamens in bud; stigma truncate; ovary 1-1.75 mm; locules 2; ovules c. 10-17, c. 4-9 per loculus. **Berry** black, 11-13 mm long, slightly elongated to slightly obovate, crowned by the erect or slightly incurved calyx lobes; pericarp thin; seeds 1, 9-10 mm, shaped like a

question mark, due to proximal dislocation of the hilum; testa pale cream, shiny, pergaminaceous; embryo eugenioide.

Examined material - **Brazil. Distrito Federal:** Cristo Redentor, 30 Oct 1984, *Filgueiras* 1154 (IBGE, UB); ibid., *Filgueiras* 1155 (IBGE, UB); Sobradinho, 8 Aug 1963, *Heringer* 9708 (UB); Cristo Redentor, 11 Jan 1990, *Pereira Neto & Oliveira* 521 (IBGE); (Reserva Ecológica do) Jardim Botânico de Brasília, 1125 m, 13 Feb 1989, *Proença* 704 (HEPH); **Mato Grosso:** 7 km SW of Xavantina, 650 m, 14 Aug 1967, *Ratter & Ramos* 351 (E).

Distribution - Endemic to the Distrito Federal, Goiás and perhaps Mato Grosso.

Discussion - There can be little doubt that the material treated here is conspecific to the type of *E. piloesis,* which was collected by St. Hilaire in the Serra dos Pilões not far from the Distrito Federal border. This taxon belongs to the *Eugenia pluriflora* complex; it differs from other member of the complex by the shrubby habit, large leaves with obscure venation and dense glandular dots, obovate fruit and proximally tapering seed with a very pale testa. The Ratter n. 351 collection from Mato Grosso, which is a small tree c. 2 m, is tentatively referred to this species. This group is in need of biosystematic studies to establish convincing species.

14. ***Eugenia punicifolia*** (H. B. K.) DC., *Prodromus* 3: 267. 1828. Based on *Myrtus punicifolia (punicaefolia)* (Holotype P? n. v.) (**Fig. 3.21 & 4.2 f**)

Syn.: *Myrtus oleaefolia* H. B. K., *Nova genera et species plantarum* 6: 147. 1823. Type. 'Crescit ad ripam fluminis Marañon (Provincia Jaen de Bracamoros). Floret Augusto' *Humboldt & Bonpland* s. n. (Holotype P n. v.)

Myrtus punicaeolia H. B. K., *Nova genera et species plantarum* 6: 149. 1823. Type. 'Crescit prope Cumanam, in monte Imposible, alt. 297 hex. Floret Septembri.' *Humboldt & Bonpland* s. n.

? *Eugenia clinocarpa* DC., *Prodromus* 3: 267. 1828. Type. Brazil. Bahia: *Martius* s. n. (Holotype M n. v.)

? *Eugenia fruticulosa* Mart. ex DC., *Prodromus* 3: 270. 1828. Type. Brazil. São Paulo: *Martius* s. n. (Holotype M n. v.)

? *Eugenia myrtillifolia* DC., *Prodromus* 3: 265. 1828. Type. Brazil. Minas Gerais:

Martius s. n. (Holotype M n. v.)

? *Eugenia sancta* DC., *Prodromus* 3: 267. 1828. Type. Brazil. Bahia: *Martius* s. n. (Holotype M n. v.)

? *Eugenia dipoda* DC., *Prodromus* 3: 268. 1828. Type. Guiana: *Perottet* s. n. (Holotype G-DC n. v.)

Eugenia coarensis DC., *Prodromus* 3: 267. 1828. Type. Brazil. Amazonas: 'Ad Rio Negro' Martius s. n. (Holotype M n. v.)

? *Eugenia kochiana* Berg, *Prodromus* 3: 268. 1828. Type. Brazil. Bahia: *Martius* s. n. (Holotype M n. v.)

Eugenia kunthiana var. *alfa* DC., *Prodromus* 3: 265. 1828. nom. illeg. to be substituted by *Eugenia kunthiana* var. *kunthiana.*

Eugenia kunthiana var. *beta* DC., *Prodromus* 3: 265. 1828. nom. illeg. Type. Brazil. Bahia: *Martius* s. n. (Holotype M!)

Eugenia kunthiana var. *gama* DC., *Prodromus* 3: 265. 1828. nom. illeg. Type. Brazil. Bahia: Inter S. Anna et S. Antonium das Queimadas, Apr 1819, *Martius* s. n. (Holotype M? BR? n. v., Isotype K!)

Eugenia kunthiana DC., *Prodromus* 3: 264. 1828. Type. Brazil. Minas Gerais: Ad Cachoeira do Campo, *Martius* s. n. (Holotype M n. v. Isotype K!)

Eugenia oleaefolia (H. B. K.) DC., *Prodromus* 3: 270. 1828. Based on *Myrtus oleaefolia.*

? *Eugenia obtusifolia* Camb., *Florae Brasiliensis Meridionalis* 2: 368. 1833. Type. Brazil. Minas Gerais: *St. Hilaire* s. n. (Holotype P n. v.)

? *Eugenia ovalifolia* Camb., *Florae Brasiliensis Meridionalis* 2: 350. 1833. Type. Brazil. Rio de Janeiro: *St. Hilaire* s. n. (Holotype P? n. v.)

? *Eugenia decumbens* Camb., *Florae Brasiliensis Meridionalis* 2: 339. 1833. Type. Brazil. Minas Gerais: 'In monte Serra do Ibitipoca locis altis siccisque. Lecta cum fructibus maturis Martio' *St. Hilaire* s. n. (Holotype P? n. v.)

Eugenia subalterna Benth., *London J. Bot.* 2: 320. 1840. Type. Guyana: 183?, *Schomburgk* 634 (Holotype K n. v. Isotypes E! F!)

Eugenia benthamii Berg, *Linnaea* 27: 164. 1855. Type. Guyana: *Schomburgk* 733 (Holotype W n. v., Isotype F!)

Eugenia pyrrhoclada Berg, *Linnaea* 27: . 1855. Type.

? *Eugenia surinamensis* Miq. ex Berg, *Linnaea* 27: 182. 1855. Type. Surinam: *Kappler* 1401a (Holotype W n. v.)

? *Eugenia pyramidalis* Berg, *Fl. Bras.* 14(1): 236. 1857. Type. Brazil. Minas Gerais: *Pohl* 3083 (Holotype W n. v.)

? *Eugenia arbutifolia* Berg, *Fl. Bras.* 14(1): 306. 1857. Type. Brazil. Bahia:

Martius s. n. (Holotype M n. v.)

Eugenia arctostaphyloides Berg, *Fl. Bras.* 14(1): 217. 1857. Type. Brazil. Bahia: Inter S. Anna et S. Antonium das Queimadas, Apr 1819, *Martius* s. n. (Holotype M!)

Eugenia boliviensis Berg nec Rusby, *Fl. Bras.* 14(1): 221. 1857. Type. Bolivia: Chiquitos, *D'Orbigny* 749 (Holotype BR n. v.).

Eugenia ciarensis Berg, Fl. Bras. 14(1): 235. 1857. Type. Brazil. Ceará: *Gardner* 1612 (Holotype W n. v. Isotype K! F!)

Eugenia decorticans Berg, *Fl. Bras.* 14(1): 240. 1857. Type. Brazil. Paraná: Ad S. Ignatii, *Sellow* s. n. (Holotype originally B, LE? n. v., Isotype K!)

Eugenia diantha Berg, *Fl. Bras.* 14(1): 239. 1857. Type. Brazil. Bahia: Rio São Francisco, *Blanchet* 2862 (Holotype W n. v., Isotype E! F! K!)

Eugenia diantha var. *ciliata* Berg, Fl. Bras. 14(1): 240. 1857. Nom. illeg. to be substituted by *Eugenia diantha* var. *diantha.*

Eugenia diantha var. *glabra* Berg, *Fl. Bras.* 14(1): 240. 1857. Type. Brazil. Pernambuco: Nov 1837, *Gardner* 1014 (Holotype W n. v., Isotype F! K!)

? *Eugenia linearifolia* Berg, *Fl. Bras.* 14(1): 230. 1857. Type. Brazil. Minas Gerais: *Sellow* s. n. (Holotype originally B, LE? n. v., Isotype K!)

Eugenia kunthiana var. *pellucida* Berg, *Fl. Bras.* 14(1): 236. 1857. Type. *Eugenia kunthiana.* Nom. illeg. to be substituted by *Eugenia kunthiana* var. *kunthiana.*

? *Eugenia macroclada* Berg, *Fl. Bras.* 14(1): 243. 1857. Type. Brazil. *Pohl* 1016 (Holotype W n. v.)

Eugenia maximiliana Berg non DC., *Fl. Bras.* 14(1): 323. 1857. nom. illeg. Type. Brazil: *Neuwied* 323 (Holotype M n. v.)

Eugenia polyphylla Berg, *Fl. Bras.* 14(1): 240. 1857. Type. Brazil. Minas Gerais: *Sellow* s. n. (Holotype B - destroyed, Lectotype P n. v.)

Eugenia prominens Berg, *Fl. Bras.* 14(1): 235. 1857. Based on *Eugenia kunthiana* var. *fructu-flavo* (Holotype M!)

? *Eugenia rhombocarpa* Berg, *Fl. Bras.* 14(1): 239. 1857. Type. Brazil. Minas Gerais: *Widgren* 540 (Holotype MEL n. v.)

? *Eugenia romana* Berg, *Fl. Bras.* 14(1): 264. 1857. Type. Brazil. Minas Gerais: *Pohl* 2969 (Holotype W n. v.)

Eugenia subcorymbosa Berg, *Fl. Bras.* 14(1): 295. 1857. **nov. syn.** Type. Brazil. Goiás: *Gardner* 4164 (Holotype W n. v. Isotype F!)

Eugenia triphylla Berg, *Fl. Bras.* 14(1): 243. 1857. Type. Brazil. Paraná: *Sellow* s. n. (Holotype originally B, LE? n. v.)

Eugenia vaga Berg, *Fl. Bras.* 14(1): 238. 1857. Illegal nom. nov. for *Eugenia punicifolia.*

Eugenia kunthiana var. *opaca* Berg, *Fl. Bras.* 14(1):236. 1857. Type. Brazil. Bahia: Rio Jequitinhonha, *Pohl* 3135 (Lectotype hereby designated W n. v., Isotype K!).

Eugenia dasyantha Berg, *Fl. Bras.* 14(1) *Supl.:* 572. 1859. Type. Brazil. Minas Gerais: 'in campis siccis floret Junio' *Riedel* s. n. (Holotype LE n. v.)

? *Eugenia glareosa* Berg, Fl. Bras. 14(1) *Supl.:* 579. 1859. Type. Brazil. Minas Gerais: *Riedel* s. n. (Holotype LE n. v.)

? *Eugenia rupestris* Berg, *Fl. Bras.* 14(1) *Supl.:* 570. 1859. Type. Brazil. Minas Gerais: *Riedel* s. n. (Holotype LE n. v.)

Eugenia mugiensis Berg, *Fl. Bras.* 14(1) *Supl.:* 571. 1859. Type. Brazil. São Paulo: 'in campis graminosis prope Taubaté et Mugy' *Riedel* s. n. (Holotype LE n. v.)

? *Eugenia calycolpoides* Griseb., *Fl. Brit. W. Indian Islands:* 238. 1860. Type?

Eugenia discolor Barb. Rodr. ex Chod. et Hassl. non DC., *Bull. Herb. Boissier (Ser. 2)* 1: 804. 1903. Nom. illeg. Type. Paraguay: *Hassler* 4397 (Holotype G n. v.)

? *Eugenia erythrocaula* Barb. Rodr. ex Chod. et Hassl., *Bull. Herb. Boissier (Ser. 2)* 1: 805. 1903. Type. Paraguay: *Hassler* 1714, 6759 (Syntypes G n. v.).

? *Eugenia stenophylla* Barb. Rodr. ex Chod. et Hassl., *Bull. Herb. Boissier (Ser. 2)* 1: 805. 1903. Type. Paraguay: 'in dumetis pr. Tobaty' *Hassler* 6337 (Lectotype G n. v.)

? *Eugenia valenzuelensis* Barb. Rodr. ex Chod. et Hassl., *Bull. Herb. Boissier (Ser. 2)* 1: 805. 1903. Type. Paraguay: *Hassler* 1714, 6759 (Holotype G n. v.)

? *Eugenia psammophila* Diels, *Bot. Jahr. Syst.* 37: 598. 1906. Type. Brazil. Amazonas: *Ule* 5968 (Holotype B - destroyed, Lectotype G n. v.)

Pseudomyrcianthes kochiana (DC.) Kausel, *Ark. Bot.* 3: 505. 1956. Based on *Eugenia kochiana.*

Shrubby **tree** to subshrub 0.15-3 m. **Hairs** mostly whitish, short to minute, very fine, sometimes reddish on vegetative buds; vegetative buds, petioles leaves, bracts and ovary sometimes pubescent or strigulose, if so the pubescence denser on the leaves below than above; pedicels and sepals sometimes with sparse hairs; staminal disk always pubescent; sepals inside, petals, style and mature fruit glabrous. Bark of trunk peeling like very thin paper, dark reddish-brown beneath; young branches sometimes shiny, reddish brown. Mature **leaves** 1.7-10

x 0.6-4.4 cm, 1.1-5.3 times as long as wide, elliptic to obovate; apex rounded or barely acuminate, rarely slightly emarginate, the acumen short, thick and round-tipped; base rounded to acute, decurrent on petiole; petiole 1-4 x 1.25-1.5 mm. **Flowers** solitary or in 2(-5) flowered umbel-like racemes; racemes axillary to 2 cm; peduncle or axis usually absent, sometimes to 4 mm; bracts and bracteoles mostly persistent in the fruit; bracteoles ovate, sometimes slightly carinate, rounded or acute, 1-2.5 mm; pedicels 2-15 x 0.5-1 mm; mature buds 4-7 x 3.25-5 mm, capitate to pear-shaped; anthesis occurs as the 4 sepals open; slight tearing at the sinuses may occur as ovaries develop. Calyx lobes ciliate, in two subequal to unequal pairs, the outer pair smaller, 1-2.5 mm, transverse-oblong to rounded, the inner pair larger, 2-4 mm, squarish to rounded; hypanthium not prolonged above stylar insertion. Petals 4-8 mm, elliptic to round, barely glandular, ciliate. Staminal disk 2.5-3.5 mm across, flat, square; stamens c. 68-92 in 3 irregular whorls, 3-4.5 mm; anthers 1-1.5 mm, oblong, with a minute to conspicuous apical gland. Style (1.5-) 5.5-7 mm, incurved in bud; stigma truncate; ovary c. 2 mm; locules 2; ovules attached to a central placenta, c. 14-23, c. 6-13 per loculus. **Berry** maturing yellow, orange and finally orange-red with green, incurved calyx sepals, 10-12 mm long; pericarp thin; seeds1(-2), 6-8.5 mm, elliptic; testa yellowish-cream, shiny, cartilagineous, roundish to slightly elongated; embryo eugenioide.

Examined material - **Brazil: Distrito Federal:** Reserva Ecológica do IBGE, 2 Jul 1990, *Azevedo & Lopes* 747 (IBGE);, Peninsula Norte, 28 Oct 1978, *Ratter & Bastos* 4221 (E, K);, Fazenda Agua Limpa, 12 Jul 1979, *Cesar* 552 (UB); , Fazenda Agua Limpa, 19 Jul 1979, *Cesar* 695 (E);, (Reserva Ecológica do) Jardim Botânico de Brasília, 13 May 1985, *Equipe do Jardim Botânico de Brasília* 417 (HEPH); (Reserva Ecológica do) Jardim Botânico de Brasília, 1100 m, 6 Aug 1985, *Equipe do Jardim Botânico de Brasília* 518 (IBGE); (Reserva Ecológica do) Jardim Botânico de Brasília, 1100 m, 20 Oct 1986, *Equipe do Jardim Botânico de Brasília* 768 (HEPH); Brasília, 15 Mar 1965, *Heringer* 10106 (UB); Brasília, Plano Piloto, 18 Dec 1967, *Heringer* 11603 (UB); Chapada da Contagem, 1350 m, 14 Mar 1976, *Heringer* 15482 (UB); Reserva Ecológica do IBGE, 30 Feb 1982, *Heringer* 18355 (IBGE); Bacia do Rio São Bartolomeu, 12 Aug 1980, *Heringer & Filgueiras* 5297 (IBGE); RECOR, 9 Jun 1978, *Heringer & Paula* 540 (IBGE); Bacia do Rio São Bartolomeu, Ribeirão Taboca, 25 Mar 1981, *Heringer & Filgueiras* 6591 (IBGE); Bacia do Rio São Bartolomeu, 15 Jun 1981, *Heringer & Filgueiras* 7049 (IBGE); Parque Nacional de Brasília, 18 Jul 1963, *Heringer*

9269 (UB); Sobradinho, 8 Sep 1964, *Heringer* 9808 (UB); Bahia, C. 150 km SW of Barreiras, 850 m, 13 Apr 1966, *Irwin & Grear Jr.* 14695 (K); 10 km N of Planaltina, 975 m, 2 Oct 1965, *Irwin & Souza* 88?? (UB); Fazenda Agua Limpa, 2 May 1980, *Kirkbride & Neto* 1196 (UB); Escola Fazendária, 1000 m, 10 Aug 1984, *Pereira* 1047 (IBGE, UB); Fazenda Agua Limpa, 21 Sep 1976, *Ratter & Fonsêca* 3632 (E); Fazenda Agua Limpa, 14 Sep 1982, *Ratter & Machado* 4786 (E, UB); Distrito Federal, Reserva Biológica das Aguas Emendadas, 1100 m, 17 Jul 1984, *Proença* 149 (HEPH, UB); Fazenda Agua Limpa, 11 Sep 1984, *Proença* 403 (UB); Fazenda Agua Limpa, 11 Sep 1984, *Proença* 404 (UB); Reserva Biológica das Aguas Emendadas, 1100 m, 10 Mar 1984, *Proença* 449 (HEPH); Nov 1984, *Maria Theresa* s. n. (UB); **Goiás:** Morrinhos et à Serra dos Pyreneus, 1896, *Glaziou* 21146 (K); *Gardner* 4164 (F); Rodovia Anápolis-Jaraguá, 30 Sep 1974, *Heringer* 14030 (IBGE); 15 km ao S de Luziânia, 30 Nov 1981, *Heringer* 18266 (IBGE); 15 km ao S de Luziânia, 11 Feb 1982, *Heringer* 18280 (IBGE); Near Padre Bernardo about 140 km N of Brasília, 23 Sep 1972, *Ratter & Fonsêca* 2497 (K); **Minas Gerais:** Campo do Meio, 14 Sep 1983, *Carvalho et al.* 2742 (UEC); 1840, *Claussen* s. n. 4 (F); Alpinópolis, 27 Jul 1982, *Davide et al.* 3543 (UEC); Environs d'Ouro Preto et de Rio de Janeiro, *Glaziou* 14286 (K); *Glaziou* 16982 (K); Serra do Lenheiro, *Glaziou* 16985 (K); Diamantina, 1892, *Glaziou* 19374 (K); Formoso, Parque Nacional Grandes Sertões, 31 Jul 1989, *Dias & Walter* 60 (IBGE); João Pinheiro, 16 Feb 1972, *Heringer* 12041 (UEC); Ad Cachoeira do Campo, *Martius* s. n. (K); Diamantina, 1250 m, 12 May 1931, *Mexia* 5809 (K); Diamantina, Serra do Rio Grande, 1290 m, 13 May 1931, *Mexia* 5843 (K); Parque Nacional Grandes Sertões, 31 Jul 1989, *Dias & Walter* 55 (IBGE); Formoso, Parque Nacional Grande Sertão Veredas, 760 m, 31 Jul 1989, *Pereira Neto & Dias* 420 (IBGE); Pimenta, 12 Oct 1982, *Santos et al.* 3261 (UEC); Santana do Riacho, 6 Mar 1982, *Semir & Martins* 13456 (E); **São Paulo:** Botucatú, 31 Jul 1986, *Bicudo & Campos* 1328 (UEC); Botucatú, 15 Aug 1986, *Bicudo & Campos* 1352 (UEC); Botucatú, 11 Sep 1986, *Bicudo & Campos* 1435 (UEC); Ipanema, 29 Aug 1914, *Davie?* 139 (K); São Simão, Reserva de Cerrado da Fazenda Santa Maria, 1 Feb 82, *Leitão Filho & Martins* 13315 (E, UEC); Luiz Antônio, 10 Feb 1987, *Leitão Filho & Martins* 18921 (UEC); Assis, Feb 1988, *Leitão Filho & Rodrigues* 20102 (UEC); Itirapina, 3 Sep 1980, *Giannotti* 12321 (UEC); Ypanema, 1818, *Martius* s. n. (M); Pr. Villa Franca, Jul 1834, *Riedel* 2382 (K); São Carlos, 1 Oct 1980, *Semir & Cruz* 11546 (UEC); Itirapina, 900 m, 23 Feb 1978, *Shepherd & Semir* 7295 (UEC); **Bahia:** Serra Açurua? (Serra da Jacobina on specimen at F), Rio São Francisco, *Blanchet* 2862 (E, F, K); Entre Correntina e Posse 110 km a

sudoeste de Correntina, 680 m, 28 Jul 1989, *Dias &Walter* 25 (IBGE); C. 14 km S of Barra da Estiva near the Ibicoara road, 1100 m, 2 Feb 1974, *Harley & Renvoize* 15836 (K); 16 km S of Lagoinha on side road to Minas do Mimoso, 950 m, 4 Mar 1974, *Harley & Renvoize* 16720 (K); 25 km WNW of the Vila de Rio de Contas, 1400 m, 20 Mar 1977, *Harley & Mayo* 19739 (E); 1.5 km S of Brejinho das Ametistas, Serra Geral de Caitité, 900 m, 11 Apr 1980, *Harley & Bromley* 21236 (E); Fluvium Itahype prope Almada et Lacum Almadensem, *Martius* s. n. (M); Rio Jequitinhonha, *Pohl* 3135 (F); **Piauí:** Oeiras, 400 m, Nov 1986, *Castro* s. n. (UEC); ibid., May 1987, *Castro* s. n. (UEC); **Pará:** Maracanã, 5 Dec 1978, *Bastos & Santos* 215 (MG); Tucuruí, 4 Jan, *Bastos & Motta* 319 (MG); Serra do Cachimbo, Cachoeira do Curuá, 320 m, 20 Feb 1977, *Kirkbride Jr. & Lleras* 2950 (MG); Curuçá, 14 Oct 1978, *Silva & Rosário* 4049 (MG); Missão Tiriyó, Rio Parú de Oeste, 19 Feb 1970, *Cavalcante* 2425 (MG); Marabá, Serra dos Carajás, 20 Apr 1970, *Cavalcante & Silva* 2684 (MG); Estrada de Vigia, 3 Jun 1958, *Cavalcante* 385 (MG); 17 km SE of Vigia along PA-140 road to Belém, 50 m, 30 Mar 1980, *Davidse & Rosa* 17653 (MG); Collares, 18 Aug 1913, *Ducke* 12665 (MG); Vigia, 6 Apr 1961, *Egler & Rodrigues* 1587 (MG); Centro de Treinamento de Maracanã, 22 Feb 1975, *Oliveira* 6260 (MG); Maracanã, 4 Jul 1977, *Oliveira* 6657 (MG); Perto do Rio Xingú, 27 Jun 1978, *Pires* 16077 (MG); Tucuruí, Breu Branco, 90 m, 17 Mar 1980, *Plowman & Rosa* 9690 (MG); Serra do Cachimbo, Cachoeira de Curuá, 4 Nov 1977, *Prance & Silva* 24755 (MG); Estrada para Vigia, 30 Dec 1967, *Silva* 1068 (MG); Marabá, 19 Mar 1984, *Silva & Rosa* 1890 (MG); Gurupá, 5 Feb 1979, *Silva & Rosário* 5013 (K); Tucuruí, 4 Jun 1980, *Silva & Rosário* 5369 (MG); **Amazonas:** Alter do Chão, Serra do Giz, 11 Mar 1909, *Ducke* 10325 (MG); Manaus, Bombeamento, 30 Oct 1943, *Ducke* 1417 (MG); Manaus, 21 May 1957, *Mello & Coelho* 3189 (MG); Across river from Maués, 20 Apr 1974, *Prance & Campbell* 22025 (MG); Km 10 of Humaitá to Porto Velho Road, 28 Nov 1966, *Prance & Pena* 3437 (K, MG); **Amapá:** E. de Porto Grande, 19 Oct 1979, *Austin & Nauman* 7124 (MG); Igarapé Ariramba, 3 Aug 1962, *Pires & Cavalcante* 52309 (MG); Macapá, Estrada de Curiaú, 3 Feb 1981, *Rabelo & R. Non.* (*Nonato* 1116 (MG); Macapá, Estrada de Cutias, 16 Jul 1980, *Rabelo & R. N.* (*Nonato* 517 (MG); Macapá, Vai-quem-quer-pacuí, 20 Jul 1980, *Rabelo & R. N.* 586 (MG); Macapá, Maruanum, 30 Oct 1980, *Rabelo & Jonas* 966 (MG); **Pernambuco:** Nov 1837, *Gardner* 1014 (F, K); **Ceará:** *Gardner* 1612 (F, K); **Rio de Janeiro:** Near Rio de Janeiro (possibly erroneous), *Glaziou* 10815 (K); **Paraíba:** Cabedelo, 1955, *Morais* 393 (K); **Mato Grosso do Sul:** Salgadeira, Chapada dos Guimarães, 4 Sep 1983, *Oliveira Filho* 147 (UEC); **Roraima:** Base

of Serra Tepequém, Boca da Mata, 10 Feb 1967, *Prance & Forero* 4291 (K, MG); Serra de Tepequém, 1500 m, 16 Feb 1967, *Prance & Forero* 4420 (MG); **Mato Grosso:** 270 km N of Xavantina, Nov 1967, *Ramos & Sousa* 49 (E); C. 270 km N of Xavantina, Nov 1967, *Ramos & Sousa* 79 (K); 26 km N of Xavantina on the Xavantina-Cachimbo Road, 31 Jul 1967, *Ratter & Ramos* 233 (E); **Paraná:** Ad S. Ignatii, *Sellow* s. n. (K); **Unknown locality:** *Blanchet* 3862B (K); *Burchell* 8495 (K); 22 Jan 1829, *Burchell* 8543 (K). **Colombia:** Vichada, Meta Region, 450 m, 3 Aug, *Sandeman* 5857 (F). **Cuba:** Isla de Pinos, near Nova Gerona, 13 Mar 1904, *Curtiss* 408 (E). **Guyana:** 183?, *Schomburgk* 634 (E, F); *Schomburgk* 733 (F). **Paraguay. Cordillera:** Cerros de Tobatí, 14 Jan 1903, *Fiebrig* 705 (E); Near Piribebuy, 18 Dec 1965, *Pedersen* 7581 (K). **Suriname. Nickerie:** Upper Sipaliwini River, *Rombouts* 523 (K).

Vernacular names and uses - Pitanga (Distrito Federal); Sete-casacas, Fruta-de-Perdiz, Fruta-de-Codorna, Murta-do-campo (Minas Gerais, Kiaerskov, 1893); Café-de-São-José, Piúna (Minas Gerais); Goiaba-verdadeira (Goiás); Araçá, Araçazuzinho (Piauí); Murta (Pará); Ginja, Goiabinha-do-campo (Amapá). The fruits are edible but rather insipid with little flesh (personal observation) but the plants are very decorative when fruiting, with shiny green, yellow and orange-red berries. I once came unawares upon a large partridge which hurriedly abandoned a copiously fruiting shrub. This, together with the common names Fruta-de-Perdiz, Fruta-de-Codorna and Pão-de-Bilós lead me to believe that these pheasant-like birds (Tynamidae) eat the fruits and might act as dispersers.

Distribution - A common, widely-distributed taxon occurring as a tree in certain kinds of dry forests in southern Brazil or as a shrub in savannas *sensu latissimo* all over South America, from Paraguay to Cuba. Very well represented in the Brazilian cerrados region or wherever isolated pockets of cerrado occur (São Paulo, Minas Gerais, Distrito Federal, Goiás, Mato Grosso, Bahia, Piauí, Maranhão, Ceará, Pernambuco), the Amazonian Campos (Amazonas, Pará, Amapá) and Guyana Shield Savannas (Venezuela, Guyanas).

Discussion - McVaugh (1958, 1969) chose this name over *Eugenia oleaefolia* which has equal priority and published several synonyms to this species. Sobral (1987), in preparation for Myrtaceae in the *Flora of Paraguay,* has recently

published an expanded description and vast new synonymy. This was based upon analysis of over 150 modern collections covering nearly the whole area of distribution of the species. Taxonomic decisions were based upon phototypes and examination of types from LE and BR (Sobral saw actual types of 6 of the 40 species synonymized). I have examined additional types or isotypes from E, F, M and K and can corroborate synonym status for another 8 specific names of which Sobral saw only phototypes. I disagree with Sobral upon two points however: 1) I have examined the original collection of the *nomem nudum E. pichoana* Glaziou and in my opinion this is referable to *Eugenia cristaensis,* not *E. punicifolia;* 2) I have some doubts as to *Eugenia linearifolia* (I examined the types of *Eugenia linearifolia* and of *E. linearifolia* var. *ternifolia,* both of which seem to me to be possibly distinct) and so have included it in the synonymy with a question mark, as I have with the other names of which neither I, McVaugh nor Sobral saw the types. Finally, I have included in the synonymy another Berg name not cited by Sobral: this is *Eugenia subcorymbosa* Berg, based upon a Gardner collection from Goiás, which in the light of the present delimitation of the species also cannot be maintained.

Many of the Berg species have two or three varieties, but Sobral does not cite them, only noting that he considers them all synonymous within the species, so I have not listed varieties unless I examined the type. As far as possible I have chosen the type specimens cited by Sobral as lectotypes where several varieties, or specimens, are involved. In Berg's descriptions in the *Flora Brasiliensis* lectotypification is usually relatively straightforward since Berg provided one complete description for one of the varieties, and then cited the distinguishing characters of the others in a few lines. In one or two cases only has another specimen been chosen, such as in the case of *Eugenia kunthiana* DC. This was originally described with three varieties by De Candolle, var. 'alfa, beta and gama'. Berg elevated varieties beta and gama to species level with other names and retained the De Candolle epithet for var. alfa, thereby typifying the species by that variety. *E. kunthiana* var. *alfa* was based upon a fruiting collection from Minas Gerais so the specimen cited by Sobral (a flowering collection from Bahia, type of var. gama) cannot be accepted as lectotype.

15. ***Eugenia uruguayensis*** Camb., *Florae Brasiliensis Meridionalis* 2: 362. 1833. Type. Uruguay: 'Ad ripas fluminis Uruguay prope castra stativa S. José in parte occidentali provinciae Cisplatinae. Florebat Januario' *Saint*

Hilaire s. n. (Holotype P? n. v.) (**Fig. 3.22**)

Syn.: *Eugenia calycosema* Berg, *Fl. Bras.* 14(1): 276. 1857. Type. Brazil (erroneously cited as Montevideo). Rio Grande do Sul: 'ad villam S. José' *Sellow* s. n. (Holotype B - destroyed)

Eugenia batucaryensis Berg, *Fl. Bras.* 14(1): 262. 1857. Type. Uruguay: 'ad Batucary in Montevideo' *Sellow* s. n. (Holotype B - destroyed)

Eugenia maschalantha Berg, *Fl. Bras.* 14(1): 278. 1857. Type. Uruguay: 'in sylvis republicae Montevideo' *Sellow* s. n. (Holotype B - destroyed)

Eugenia opaca Berg, *Fl. Bras.* 14(1): 278. 1857. Based on *Eugenia opaca* var. *montevidensis* Berg (species hereby lectotypified by this variety)

Eugenia opaca var. *montevidensis* Berg, *Fl. Bras.* 14(1): 278. 1857. Type. Uruguay: 'in fruticetis ripariis in Montevideo, floret Decembri' *Sellow* s. n. (Holotype B - destroyed)

Eugenia opaca var. *brasiliensis* Berg, *Fl. Bras.* 14(1): 278. 1857. Type. Brazil. Rio Grande do Sul: *Sellow* s. n. (Holotype B - destroyed)

Tree to 5 m, predominantly glabrous except for the minutely scabrous young branches, pedicels, staminal disks and ovaries. **Hairs** simple, golden brown. Mature leaves 3-4.6 x 1.3-2.2 cm, 2.1-2.9 times as long as wide, elliptic to lanceolate; apex acute or barely acuminate, the extreme tip blunt; base acute or cuneate; leaf margin with a thin, inconspicuous cartilagineous vein; petiole 4-6 x 1 mm. Congested raceme with 1-5 **flowers**, axillary or at leafless nodes; bracteoles c. 1 mm, conate at base or splitting apart, ovate, acute; pedicels 0.5-12 x 0.5 mm; mature buds 3.5 x 3 mm, obovate; anthesis occurs as the 4 sepals open. Calyx lobes unequal, 1-1.75 mm, minutely ciliate; hypanthium not prolonged above stylar insertion. Petals 2.5 mm, suborbicular, barely glandular, with sparse, minute cilia or eciliate. Staminal disk 2.5 mm across, circular, stamens c. 73 in c. 3 irregular whorls, crumpled in bud, extended not seen; anthers 0.5 mm, elliptic. Style c. 3 mm, curved over staminal bundle in bud; stigma truncate; ovary 1.5 mm; locules 2; ovules c. 14, c. 6-8 per loculus. **Berry** red, 8-11 mm, elliptic; pericarp thin; seed 8-9 mm, elliptic; testa pale brown, shiny.

Examined material - **Brazil. Distrito Federal:** Catetinho, 2 Aug 1975, *Heringer* 14810 (UB); Córrego Pitoco, 04 1990, *Silva Jr.* 1990 (IBGE); **Minas Gerais:** Viçosa, 675 m, 22 Sep 1930, *Mexia* 5084 (K); Viçosa, 675 m, 27 Sep 1930,

Mexia 5111 (K).

Vernacular names - Batinga-vermelha, guamirim (Santa Catarina, Legrand 1969); Jambo (Minas Gerais). In Minas Gerais, where it may grow to be a 10 m tree, the wood is used for tool handles and rafters.

Distribution - The Distrito Federal and Minas Gerais collections are much to the North of the known area of distribution, which is Santa Catarina, Rio Grande do Sul and also in Missiones in Argentina, Uruguay and Paraguay 'along the forests that border the Uruguay River and its tributaries' according to Legrand (1969). Although two collections are insufficient for conclusions, it is interesting that both were made in gallery forests on rivers (Rio São Bartolomeu and Córrego Pitoco) which do in fact belong to the Plate (Uruguay) river basin.

Discussion - This species belongs to the *Eugenia pluriflora* DC. complex; it differs from that species by the very obscure venation and lack of glandular dots on the leaves above, by presenting some pubescence on young branches and ovaries and by having slightly elongated fruit (Legrand 1969). However, an accurate delimitation of species within this group needs biosystematic studies. It is very similar also to *E. hyemalis* Camb., differing from descriptions of that species (Kawasaki 1989, Legrand 1969) by the sparsely punctate leaves below. It is distinct from E. *piloesis, E. bimarginata* and *E. piauhiensis,* the other species of the complex which occur in the Distrito Federal, by a combination of arboreal habit, small leaves with inconspicuous venation and minutely scabrous young branches, staminal disks and ovaries.

Legrand (1936) devoted considerable energy to the investigation of this species, common in northern Uruguay and unidentified when he initiated his studies of the Uruguayan Myrtaceae. At his request, Max Burret of Berlin compared new Uruguayan material with the then extant types of four Berg names, *E. opaca, E. calycosema, E. maschalantha* and *E. batucaryensis.* Although Burret himself apparently supported the union of *E. opaca* with *E. batucaryensis* but not with the other two names, Legrand believed the material to be all conspecific and consequently adopted the name *E. opaca* for an amalgamation of the four species (including the two varieties of *E. opaca*); he later examined a phototype of *E. uruguayensis* and came to the conclusion that the older Cambessèdes name was conspecific and must be taken up for this species. Later on, in the discussion of this species in the *Flora Ilustrada*

Catarinense (Legrand & Klein 1969), he recognized an *E. uruguayensis* var. *opaca,* but this was not formally described as it does not occur in Santa Catarina and the rules to the *Flora* forbade the description of extra-regional taxa. This undescribed taxon, as envisaged by Legrand, would include *E. opaca, E. maschalantha* and *E. guabyu* in its synonymy; the synonyms *E. calycosema* and *E. batucaryensis* would be restricted to *E. uruguayensis* var. *uruguayensis.* The Distrito Federal specimen would fall into the former variety, but I have chosen not to describe it, for although I have no reason to doubt Legrand's decision neither have I for accepting it, having seen no Paraguayan and Uruguayan material. I have included in the synonymy all the species whose types were compared by Burret but not *E. guabuyu,* since there are discrepancies in its description, such as the size of the sepals and petals, which lead me to believe it could be another species.

Species of possible occurrence in the Distrito Federal

Eugenia pyriformis Camb. - A sterile collection from a calcareous forest in the North-western Distrito Federal is possibly referable to this species.

Eugenia moraviana Berg - This has been collected in Paracatú and Western Minas Gerais as well as Paraguay, so it may occur in the Distrito Federal. It is very close to *Eugenia florida,* differing by its more delicate leaves, flowers and pedicels and very pale branches.

2. *Myrciaria* Berg, Linnaea 27:136 (in clave). 1856. Fl. Bras. 14(1): 358 (1857). Lectotype: *Myrciaria tenella* (DC.) Berg, McVaugh, *Taxon* 5(6):143. 1956.

Trees or shrubs. Inflorescence a highly modified axillary raceme in which the rachis and pedicels are so contracted that it resembles a glomerule (glomerulate raceme). Bracts and bracteoles usually persistent in fruit, the bracts free, the bracteoles connate at base, embracing the very short ovary. Buds open at the apex; anthesis occurs as the 4 sepals open with deep tearing at the sinuses. Hypanthium prolonged into a cup beyond the level of insertion of the style and this cup later abscissed. Calyx lobes 4, with a smaller outer pair and a larger inner pair. Petals 4. Anthers roundish; locules opening by straight,

longitudinal slits which are parallel to the filaments. Ovary bilocular; ovules 2 (4) per loculus; stigma truncate. Berry globose, with a small, apical, discoid scar resulting from the abscission of the hypanthial cup; pericarp thin to somewhat thick. Seeds 1(-3); testa membranaceous. Embryo conferruminate, rarely presenting a false inter-cotyledonary dividing line.

Key to the species

1a Leaves above 3.5 cm, attenuate at base into a petiole 4-7 mm.....1. *M. glanduliflora*

1b Leaves usually much less than 3.5 cm long, subsessile to petiole 2 mm.....2. *M. tenella*

1. *Myrciaria glanduliflora* (Kiaersk.) Mattos & Legr., *Loefgrenia* 0 (67): 6. 1975. Based on *Eugenia glanduliflora* Kiaersk.

Syn.: *Eugenia glanduliflora* Kiaersk., *Symb. Fl. Bras. Centr.* 39: 180. Tab. 11 fig. c. 1893. Type. Brazil. Minas Gerais: Serra da Piedade, *Warming* 78 (Holotype C!) (**Fig. 3.24**)

Shrub or tree 1.5-3 m. Hairs whitish, minute; branches, leaves and petioles puberulent when young. Branches whitish, compressed, sometimes with rather loose bark. Mature **leaves** 3.3-7.6 x 0.8-2.5 cm, 3.6-4.1 times as long as wide, oblanceolate; apex acute; base atenuate; margin revolute; petiole 4-7 x 1-1.5 mm. **Flowers** 2-8 in glomerulate, axillary or cauliflorous raceme; bracteoles c. 1-1.25 mm, conate at base, ovate, rounded; pedicels absent or almost so; mature buds 1.5-2 x 1.25-1.5 mm; anthesis occurs as the 4 sepals and petals open. Calyx lobes subequal, c. 1 mm, glandular-verruculate, ciliate; hypanthium prolonged into a cup which dehisces at its base after fertilization; locules 2; ovules 4, 2 per loculus. Open flowers and fruit not seen

Examined material: **Brazil. Distrito Federal:** Reserva Ecológica do IBGE, 10 May 1990, *Silva Jr.* 344 (IBGE); Reserva Ecológica do IBGE, 21 Jun 1990, *Silva Jr.* 584 (IBGE); **Minas Gerais:** Serra da Piedade, *Warming* 78 (C).

Distribution - Known previously only from the Serra do Cipó and the Serra da Piedade (mountain ranges in Minas Gerais), this species has been recently

collected in sterile condition in a gallery forest in the Distrito Federal.

Discussion - A very characteristic species, unlikely to be confused with any other taxa.

2. ***Myrciaria tenella*** (DC.) Berg, Fl. Bras. 14(1): 368. 1857. Based on *Eugenia tenella* DC. (**Fig. 3.24**)

Syn: *Eugenia tenella* DC., Prodr. 3:272. 1828. Type: Brazil. Minas Gerais: Martius s. n. (Holotype M? n. v.)

Eugenia tenella var. *minor* Camb., Fl. Bras. Merid. 2:346. 1833. Type: Brazil. São Paulo: 'prope Morongava in parte prov. dicta Campos Geraes', Saint Hilaire s. n. (Holotype P? n. v.)

Myrciaria herbacea Berg, Fl. Bras. 14(1): 369. 1857. **syn. nov.** Type: Brazil. Minas Gerais: 'Ad S. Anna et Pompeo', Dec 1818?, *Sellow* s. n. (Holotype B - destroyed, Isotype K!).

Myrciaria minensis Berg, Fl. Bras. 14(1): 369. 1857. **syn. nov.** Type: Brazil. Minas Gerais: *Gardner* 4653 (Holotype W n. v., Isotype F!).

Myrciaria tenella var. *elliptica* (DC.) Berg, Fl. Bras. 14(1): 368. 1857. Nom. illeg. to be sustituted by *Myrciaria tenella* var. *tenella*..

Myrciaria tenella var. minor (Camb.) Berg, Fl. Bras. 14(1): 368. 1857. Based on *Eugenia tenella* var. *minor*.

Myrciaria tenella var. spathulata Berg, Fl. Bras. 14(1): 368. 1857. Type: Brazil. Rio Grande do Sul: 'ad Itanaré' Sellow s. n. (Holotype B - destroyed).

Shrubs 0.25-0.4 m (- small trees ?); vegetative parts sparsely to barely pubescent, the pubescence usually denser and more persistent on petioles and the lower surface of the midvein, the bracts and sepals sometimes obscurely puberulent, the petals, staminal disk and ovary glabrous. Mature **leaves** 1.3-3.6 x 0.6-1.3 cm, 2.2-3.5 times as long as wide, elliptic or rarely ovate; apex acute or faintly acuminate, the extreme tip blunt to cuspidate; base acute to obtuse; petiole 1-2 x 0.25-0.5 mm. **Flowers** 1-4 per leaf axil; bracts and bracteoles 0.5-1 mm; mature buds 1.75-2 x 2-2.75 mm; anthesis occurring by the 4 sepals opening and partially tearing along their base. Calyx lobes subequal, 1-2 mm, ciliate, the outer pair slightly smaller and rounded, the inner pair larger and truncate; hypanthial cup prolonged 1-1.5 mm above stylar insertion level. Petals 1-2.5 mm, densely ciliate. Staminal disk 2-2.25 mm across, circular; stamens

60-110, in 2 nearly superimposed whorls, 2.5-5 mm; anthers 0.25-0.5 mm, oblong, obscurely glandulate at the apex. Style 4-6 mm; ovary slightly protruding above the hypanthium to almost free, 0.5-0.75 mm; locules 2, either 2- or 4-ovulate; ovules either 4 or 8. **Berry** (fide Legrand, 1978) roundish, black, crowned by a circular scar, usually 1-seeded; embryo eugenioide.

Examined material - **Brazil. Goiás:** Luziânia, 15 Dec 1980, Heringer 18010 (IBGE, UB). Minas Gerais: S. Anna et Pompeo, Dec 1818?, *Sellow* s. n. (K); *Gardner* 4653 (F).

Distribution - A widely-distributed species ranging from Salta and Jujuy in Argentina to Maranhão in northern Brazil (Legrand 1978). It is very common as a small tree in the south-brazilian coastal forest but occasionally occurs in shrubby form and as such has been collected a few km from the Distrito Federal boundaries in Goiás.

Discussion - This is a familiar pattern for forest Myrtaceae meeting more open vegetation. I do not believe that the shrubby habit alone is enough to warrant taxonomic recognition so I have submerged *Myrciaria herbacea* and followed Legrand in not recognizing *M. tenella var. minor.*

Based on the description *M. cuspidata* is possibly yet another shrubby form distinguished mainly by its completely sessile leaves. Legrand (1978) states that the fruits are yellow at maturity (as opposed to black in *M. tenella*) so I have maintained it separate until further collections are available.

The type of *Myrciaria minensis* fits perfectly into the modern concept of *Myrciaria tenella* so I have also reduced this name to a synonym of the latter.

3. ***Siphoneugena*** Berg, Linnaea 27:345. 1856. Lectotype: *S. widgreniana* Berg, *Notizbl. Bot. Gart. Berlin-Dahlen* 15: 536 (Burret 1941)

Syn.: *Eugenia* subgen. *Siphoneugena* (Berg) Kiaerskou in Warming, E. *Symb. Fl. Bras. Centr.* 39:174. 1893.*Calycorectes* subgen. *Siphoneugenia* (Berg) Niedenzu, *Natürl. Pflanzenfam.* 3(7):82. 1893.

Calycorectes sect. *Eusiphoneugenia* Niedenzu, *loc. cit.* Type: *C. widgrenianus* (Berg) Niedenzu.*Calycorectes* sect. *Prosiphoneugenia* Niedenzu, *loc. cit.* Type: *C. densiflorus* (Berg) Niedenzu.

Paramitranthes Burret, Notizbl. Bot. Gart. Berlin-Dahlen 15:537. 1941a. Type:

P. kiaerskoviana Burret

Trees. Inflorescence a normal or modified axillary raceme in which the rachis may be so contracted that it resembles a sessile umbel. Bracts and bracteoles free, usually persistent in fruit. Buds open at the apex with anthesis ocurring by unfurling of the calyx lobes (Distrito Federal) to completely closed. Hypanthium prolonged into a funnel-shaped cup beyond the level of insertion of the style, and this cup abscissed after pollination. Calyx lobes 4, with a smaller outer pair and a larger inner pair. Petals 4, white, imbricate, pubescent. Anthers oblong; locules opening by straight, longitudinal slits which are parallel to the filaments. Ovary bilocular; ovules 3-7 per locule; stigma puntiform. Berry black, globose, with a small, apical, discoid scar resulting from the abscission of the hypanthial cup; pericarp thin. Seeds 1(-3); testa membranaceous. Embryo with free, fleshy, plano-convex cotyledons like in a pea and a minute, prostrate hypocotyl.

A typically neotropical montane genus with 8 species distributed from the West Indies to Northern Argentina (Proença 1990). *S. densiflora* is the only species to grow in the Distrito Federal.

1. ***Siphoneugena densiflora*** Berg var. ***densiflora*** in Martius, *Fl.Bras.* 14(1):379. 1857. *Linnaea* 27:345.1856., nom. nud. (**Fig. 3.25 & 4. 2 e**)

Syn.: *Eugenia chnoosepala* var. *chnoosepala* Kiaerskov in Warming, *Symb. Fl. Bras. Centr.* 39: 174 Tab. 23 fig. h. 1893., p. p., Type: Brazil. Minas Gerais: 'Lagoa Santa' *Warming* s. n. (Holotype C!)

E. chnoosepala var. *regnelliana* Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:174. Type: Brazil. Minas Gerais: *Regnell 3-580,* 3 Set 1864 (Holotype C!, Isotypes R! ST!)

Calycorectes densiflorus (Berg) Niedenzu in Engler et Prantl, *Natürl. Pflanzenfam.* 3(7):8. 1893. Based on *Siphoneugena densiflora.*

Eugenia chnoosepala var. *latifolia* Glaziou, *Bull. Soc. Bot. France* 54(3):236. 1908., nom. nud.

Paramitranthes bracteata Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:544. 1941. Type: Brazil. Minas Gerais: Caldas, *Regnell 3-582,* 1 Aug 1846 (Holotype B - destroyed, Isotype ST!)

P. chnoosepala (Kiaerskou) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:543.

1941.

P. densiflora (Berg) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:543. 1941.

P. macrophylla Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:543. 1941.(based on *E. chnoosepala* var. *latifolia* Glaziou, nom. nud.) Type. Brazil. Minas Gerais: 'Paiol' *Glaziou* 21183 (Holotype B - destroyed, Isotypes C! R!)

P. regnelliana (Kiaerskou) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:543. 1941.

Siphoneugena bracteata (Burret) Kausel, *Lilloa* 32: 367. 1967.

S. chnoosepala (Kiaerskou) Kausel, *Lilloa* 32: 367. 1967.

S. macrophylla (Burret) Kausel, *Lilloa* 32: 367. 1967.

S. regnelliana (Kiaerskou) Kausel, *Lilloa* 32: 367. 1967.

S. macrophylla var. *brasiliae* Mattos, *Loefgrenia* 71:1 1977. Type. Brazil, Distrito Federal, Brasília, *Irwin et al* 8464 (Holotype UB!)

S. chnoosepala var. *macrophylla* (Burret) Mattos & Silveira, *op. cit.* 87:1. 1985.

S. chnoosepala var. *pilosa* Mattos & Silveira, *loc. cit.* Type. Brazil. Distrito Federal: Chapada da Contagem, *Irwin & Soderstrom 5318* (Holotype UB !, Isotype F! MICH! NY!)

Tree up to 12 m, predominantly glabrescent. **Hairs** simple, colourless to pale grey. Branchlets, petioles and leaves sometimes sparsely puberulous when young, glabrous with age; branches of the inflorescence, pedicels, bracts, bracteoles and sepals sometimes puberulent; inner surface of sepals, petals and staminal disk pubescent. Branchlets with non-peeling bark. **Leaves** 4-13.7 x 1.4-5 cm, ovate to elliptic; apex acuminate; base acute; petiole 3-14.5 x 1-2 mm; blade almost always minutely glandular-dotted against the light. Raceme normal or umbel-like, 0.8-2.7 cm, with 2-7(-14) **flowers**; bracts and bracteoles usually persistent until fruit maturation, triangular to lanceolate, c. 1 mm; pedicels 0-15 mm; **buds** ca. 3.5-2-3 mm, pear-shaped. Calyx lobes c. 1 x 1-1.5 mm, triangular, ciliate; hypanthium prolonged c. 2 mm above style base level. Petals 1.5-2.5 x 1.5-2 mm, obovate to round, ciliate. Stamens c. 65-110, incurved in bud, 1.5-5 mm. Ovary c. 1 mm; style 4.5-7 mm. **Berry** black, shiny, 9-12 mm; seeds 6-8 mm, widely ellipsoid to ovoid; testa cartilagineous, shiny, very pale pinkish brown.

Examined material: **Brazil. Distrito Federal:** Parque Nacional de Brasília,

Barragem Santa Maria, 16 Jun 1970, *Fonsêca* 1609 (UB); Horto do Guará, 19 Aug 1961, *Heringer* 8600 (NY, RB, UB); ibid., 8 Aug 1962, *Heringer* 8960 (UB); Mata do Catetinho, 26 Sep 1973, *Heringer* 12855 (UB, UEC); ibid., 5 May 1976, *Heringer* 15515 (UB); ibid., 4 Nov 1979, *Heringer* 15610 (IBGE); ibid., 3 Sep 1980, *Heringer et al.* 5433 (IBGE, NY); Estação Florestal Cabeça do Veado, 1 Aug 1975, *Heringer* 14789 (UB, UEC); Reserva Biológica das Aguas Emendadas, 2 Aug 1975, *Heringer* 14792 (UB, UEC); ibid., 2 Aug 1975, *Heringer* 14801 (UB); ibid., 3 Aug 1975, *Heringer* 14820 (UEC, NY); ibid., 17 Jul 1979 '1980', *Heringer et al.* 1861 (IBGE, NY); Bacia do Rio São Bartolomeu, 24 Jul 1979, *Heringer et al.* 1903 (IBGE, NY); ibid., 8 Aug 1979, *Heringer et al.* 1923 (IBGE, NY); ibid., 26 Sep 1979, *Heringer et al.* 2067 (IBGE); ibid., 17 Jul 1980, *Heringer et al.* 5249 (IBGE, NY); ibid., 17 Jul 1980, *Heringer et al.* 5250 (IBGE, NY, UEC); Taguatinga, Mata vizinha ao Estádio Serejão, 27 Aug 1980, *Heringer et al.* 5363 (IBGE, NY); Chapada da Contagem, 15 Aug 1964, *Irwin & Soderstrom* 5150 (UB); ibid., 19 Sep 1965, *Irwin et al.* 8464 (MICH, NY); ibid., c. de 20 km E of Brasília, 19 Aug 1964, *Irwin & Soderstrom* 5318 (UB, F, K, MICH, NY); Catetinho, 12 Sep 1964, *Irwin & Soderstrom* 6142 (F, K, MICH, NY, RB, UB); 10 km N of Planaltina, 2 Oct 1965, *Irwin et al.* 8882 (MBM, MICH, NY, UB); Parque Nacional de Brasília, 22 Jul 1965, *Martin* 413 (UB); ibid., 26 Jul 1965, *Martin* 457 (UB); Reserva Ecológica do IBGE, 8 Sep 1983, *Pereira* 745 (IBGE); Jardim Botânico de Brasília, 13 Sep 1984, *Proença* 407 (UB); Fazenda Agua Limpa, 31 Jul 1984, *Ratter & Rocha* 5011 (E, K) Near Cabeça do Veado, 23 Oct 1980, *Rivera* s. n. **Goiás:** Cristalina, 14 Aug 1980, *Hatschbach* 43123 (MBM); Saia Velha, 1 Aug 1965, *Heringer* 10473 (IBGE); Luziânia, 15 Jul 1979, *Heringer* 17369 (NY, UEC); ibid., Rio Vermelho a 15 km ao sul da Cidade, 30 Sep 1980, *Heringer* 17915 A (IBGE);ibid., 20 Aug 1980, *Heringer* 18068 (IBGE, UB). **Minas Gerais:** Patos de Minas, 800 m da Olaria, 24 Aug 1950, *Duarte* 2872 (F, K, NY, UB); Lagoa do Cercado, 22 Oct 1895, *Glaziou* 21183 (K, R); Estação Experimental Coronel Pacheco, 20 Jul 1945, *Heringer* 1955 (SP); Serra do Rio Preto, c. 4 km E of Goiás-Minas Gerais border, 19 Nov 1965, *Irwin et al.* 10516 (MBM, MICH, NY, UB); Perto de Poços de Caldas, 7 Dez 1971, *Mattos* 15640 *& Mattos* (SP); ibid., 7 Dez 1971, *Mattos & Mattos* 16382 (SP); Serra de Caldas, fr, 18 x 1847, *Regnell* 3-580 (ST); ibid., 1847, *Regnell* III-580 (R); ibid., 3 Sep 1864, *Regnell* 3-580 (C, ST); ibid., 18 Nov 1864, *Regnell* 3-580 (ST); Caldas, 26 Nov 1867, *Regnell* 3-580 (ST); ibid., 1 Aug 1846, *Regnell* 3-582 (ST); Lagoa Santa, 21 Jul 1864, *Warming* s. n. (C). **São Paulo:** Paulínia, Fazenda Saltinho, 29 Jul 1977, *Gibbs & Leitão* 5521 (UEC); Caminho entre Ybiraci e Franca, 29 Jul 1966, *Mello 'Luiz Emygdio'*

2340, *Andrade* 2243 *et al.* (R); São Simão, Fazenda Bocaina, 26 Jul 1962, *Pinho* 7 (SP); ibid., 23 Dez 1964, *Pinho* 55 (SP); Inter Casa Branca et São Simão, Jul 1855, *Regnell* 3-581 (ST); Cubatão, Itatinga, 10 Aug 1899, *Collector illegible* 19 (SP). **State unknown:** *Schüch* s. n. (W).

Vernacular names - Maria-preta, Murta (Distrito Federal); Uvatinga (São Paulo).

Distribution - In montane grasslands ('campos rupestres'), cerradões, gallery forests and montane forests in southern Goiás, Distrito Federal, Minas Gerais and São Paulo. This is a common tree in cerradão and in the drier gallery forests of the Distrito Federal. It is an indicator species of 'dystrophic facies cerradão', i. e., cerradão on poor soil (Furley & Ratter 1988).

Discussion - The extensive synonymy of this species is discussed in a recent revision of the genus (Proença 1990).

Subtribe Myrtiinae

Inflorescence a solitary flower, dichasium or cyme with sessile flowers in the forks, rarely a precocious raceme (which continues vegetative growth after the flower buds are produced). Calyx lobes 4-5 or absent, flowers opening by a calyptra or by tearing of the hypanthium. Fruits with 1 to many seeds; the testa frequently bony or verrucose (pseudotesta) but sometimes membranaceous. Embryo a C-shaped or coiled swollen hypocotyl with minute, free to imperceptible cotyledons.

1. ***Blepharocalyx*** Berg, *Linnaea* 27:348 (in clave), 412. 1856. nom. conserv. prop. Lectotype. *Blepharocalyx acuminatissima* (Miquel) Berg, *Taxon* 5:138 (McVaugh 1956)

Syn.: *Heteromyrtus* Blume, *Mus. bot.* 1:76. 1850. nom. rej. prop. Type. *Myrtus umbilicata* Camb.

Temu Berg, *Linnaea* 30:710. 1861. Lectotype: *T. divaricatum* (Berg) Berg, *Taxon* 5:146 (McVaugh 1956)

Marlieriopsis Kiaersk., *Bot. Tidsskr.* 17:281. 1890. Type. *M. eggersii* Kiearsk.

Blepharocalyx subgen. *Temu* (Berg) Niedenzu in Engler & Prantl, *Nat. Pflanzenfam.* 3(7):71. 1893.

Trees. Leaves conspicuously glandular dotted against the light. Inflorescence a regularly dichotomous cyme with sessile flowers in the forks. Bracts free; bracteoles free, caducous at or before anthesis. Buds open at the apex with anthesis ocurring by opening of the calyx lobes (Distrito Federal) or completely closed opening by longitudinal rupture into 4 lobes (Chile). Hypanthium slightly prolonged above style base level or not. Calyx lobes when present 4, frequently abscissed after pollination. Petals 4, white. Anthers widely-elliptic; loculi opening by straight, longitudinal slits which are parallel to the filaments. Ovary normally bilocular; ovules 3-17 per loculus; stigma puntiform. Berry orange-red to purplish black, globose, usually with a persistent dry, square hypanthium remnant (Distrito Federal) but sometimes with 4 small, erect calyx lobes (Amazon); pericarp thin. Seeds 1(-11); testa membranaceous. Embryo with a large, c-shaped or coiled hypocotyl and free,

minute cotyledons.

A small but widespread neotropical genus which occurs from the West Indies to Chile. It has recently been reduced by Landrum (1986) to only 3 species, only one of which occurs in the Distrito Federal.

1. ***Blepharocalyx salicifolius*** (HBK.) Berg, *Linnaea* 27:413.1856. Based on *Myrtus salicifolia.* **(Fig. 3.26 & 4.3)**

Syn.: *Myrtus salicifolia* Humboldt, Bonpland & Kunth, *Nov. Gen. Sp.* 6:136. 1823. Type. Ecuador: 'Prope Loxam Novo-Granatensium' *Humboldt & Bonpland* s. n. (Holotype P n. v.)

Eugenia salicifolia (Humboldt, Bonpland & Kunth) A.P. de Candolle, *Prodr.* 3:278. 1828.

E. tweediei Hooker & Arnott, *Bot. Misc.* 3:323. 1833. Type. Uruguay: 'Islands of Corregolos' *Tweedie s. n.* (Holotype E!)

E. deserti Cambessèdes in St. Hilaire, *Fl. Bras. Merid.* 2:343. 1833. Type. Brazil. Minas Gerais: 'In pascuis prope Pé do Morro ad fines partis desertae dicta Sertão' *St. Hilaire* s. n. (Holotype P n. v.)

E. suaveolens Cambessèdes in St. Hilaire, *Fl. Bras. Merid.* 2:339. 1833. Type. Brazil. São Paulo: 'Ad rivum dictum Urussanga' *St. Hilaire* s. n. (Holotype P n. v.)

E. adamantium Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:342. 1833. Type. Brazil. Minas Gerais: 'In pascuis sabulosis prope pagulum Chapada in part provinciae dictâ Distrito dos Diamantes' *St. Hilaire* s. n. (Holotype P n. v.)

E. depauperata Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:366. 1833. Type. Brazil. Rio Grande do Sul: 'Ad ripas fluminis Jacuy prope urbem Rio Pardo in provincia Rio Grande de S. Pedro do Sul' *St. Hilaire* s. n. (Holotype P n. v.)

Myrcia mugiensis Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:327. 1833. Type. Brazil. 'In sylvis propeurbem Mugi das Cruzes in provinciâ S. Pauli' *St. Hilaire* s. n. (Holotype P n. v.)

Myrtus umbilicata Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:296. 1833. Type. Brazil. 'Ad ripas amnis Rio das Mortes in parte provinciae ... dictâ Comarca do Rio das Mortes' *St. Hilaire* s. n. (Holotype P n. v.)

Eugenia acuminatissima Miquel, *Linnaea* 19:440. 1846. Type. Brazil. Minas Gerais: *Claussen* 1518 (Holotype probably U n. v.)

Blepharocalyx tweediei (Hooker & Arnott) Berg, *Linnaea* 27:415. 1856.

B. depauperatus (Camb.) Berg, *Linnaea* 27:415. 1856.

Myrciaria deserti (Camb.) Berg, *Linnaea* 27:320. 1856.

Blepharocalyx acuminatissimus (Miquel) Berg, *Linnaea* 27:413. 1856.

B. acuminatus Berg in Martius, *Fl. Bras.* 14(1):426.1857.Type. Brazil. Minas Gerais: 'Ad rivos Ribeiro Catharina et Rib. da Prata' *Pohl* 1017 (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:125. 1986).

B. amarus Berg in Martius, *Fl. Bras.* 14(1):422. 1857. Type. Brazil or Uruguay. 'Ad ripas in prov. Rio Grande do Sul et Montevideo' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:125. 1986)

B. angustifolius Berg in Martius, *Fl. Bras.* 14(1):421. 1857. Type. Uruguay: 'In republica Montevideo' *Sellow* s. n. (Holotype B - destroyed, Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:125. 1986)

B. angustissimus Berg in Martius, *Fl. Bras.* 14(1):421. 1857. Type. Uruguay: 'In fruticetis ripariis republicae Montevideo' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at K!, *Fl. Neotropica* 45:125. 1986)

B. apiculatus Berg in Martius, *Fl. Bras.* 14(1):425. 1857. Type. Brazil. 'In prov. S. Pauli' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:125. 1986)

B. apiculatus var. *rubellus* Berg in Martius, *Fl. Bras.* 14(1):425. 1857. Type. Brazil. São Paulo: *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotypeat K!, *Fl. Neotropica* 45:125. 1986)

B. apiculatus var. *strictus* Berg in Martius, *Fl. Bras.* 14(1):425. 1857. Type. Brazil. São Paulo: *Sellow* s. n. (Holotype B - destroyed)

B. brunneus Berg in Martius, *Fl. Bras.* 14(1):427. 1857. Type. Brazil. Rio Grande do Sul: 'Ad ripas' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at LE n. v., *Fl. Neotropica* 45:125. 1986)

B. canescens Berg in Martius, *Fl. Bras.* 14(1):426. 1857. Type. Brazil. São Paulo: *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at LE n. v., *Fl. Neotropica* 45:125. 1986)

B. cuspidatus Berg in Martius, *Fl. Bras.* 14(1):424. 1857. Type. Brazil: 'In Brasilia orientali' *Pr. de Neuwied* 18. (Lectotype, Isotype at MEL n. v., *Fl. Neotropica* 45:125. 1986)

B. lanceolatus Berg in Martius, *Fl. Bras.* 14(1):422. 1857. nom. illeg.

B. lanceolatus var. *arborescens* Berg in Martius, *Fl.Bras.* 14(1):423. 1857. Type. Brazil. Rio Grande do Sul: 'Ad rivulum vulgo Guabiju haud longe a flumine Uruguay' *St. Hilaire* s. n. (Syntypes B - destroyed)

B. lanceolatus var. *frutescens* Berg in Martius, *Fl. Bras.* 14(1):423. 1857. Type.

Brazil. 'Ad rivulum vulgo Arroio de S. João' *St. Hilaire* s. n. (Holotype B - destroyed).

B. longipes Berg in Martius, *Fl. Bras.* 14(1):423. 1857. Type. Brazil. Minas Gerais: *Widgren* 550 & 553 (Syntypes MEL)

B. picrocarpus Berg in Martius, *Fl. Bras.* 14(1):427. 1857. Type. Brazil. Rio Grande do Sul: *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at K!, *Fl. Neotropica* 45:125. 1986)

B. pilosus Berg in Martius, *Fl. Bras.* 14(1):422. 1857. Type. Brazil. Rio Grande do Sul: 'Ad Freguezia de S. Anna, ad amnem Rio do Lino' *Sellow* s. n.(Holotype presumably B - destroyed; Lectotype, Isotype at K, *Fl. Neotropica* 45:125. 1986)

B. ramosissimus Berg in Martius, *Fl. Bras.* 14(1):424. 1857. Type. Brazil. Minas Gerais: 'In montibus Serra do Lenheiro et praedium Tanque' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:126. 1986).

B. sessilifolius Berg in Martius, *Fl. Bras.* 14(1):428. 1857. Type. Brazil. Minas Gerais: 'Ad Rio Jequitinhonha' *Pohl* 5768 (Holotype W n. v.)

B. sessilifolius var. *pauciflorus* Berg in Martius, *Fl. Bras.* 14(1):428. 1857. Type. *Pohl* ? (Holotype W n. v.)

B. sessilifolius var. *pluriflorus* Berg in Martius, *Fl. Bras.* 14(1):428. 1857. nom. illeg. for var. *sessilifolius.*

B. strictus Berg in Martius, *Fl. Bras.* 14(1):423. 1857. Type. Uruguay: 'Habitat in Montevideo' *Sellow* s. n. (Holotype B - destroyed)

B. villosus Berg in Martius, *Fl. Bras.* 14(1):426. 1857. Type. Brazil. Minas Gerais: 'In montibus Serra de S. Antonio' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at K!, *Fl. Neotropica* 45:125. 1986)

B. villosus var. *triflorus* Berg in Martius, *Fl. Bras.* 14(1):425. 1857. Type. Brazil. Minas Gerais: 'In montibus Serra de S. Antonio' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:125. 1986)

B. villosus var. *uniflorus* Berg in Martius, *Fl. Bras.* 14(1):426. 1857. Type. Brazil. Minas Gerais: 'In montibus Serra de S. Antonio ' *Sellow* s. n. (Holotype B - destroyed)

B. widgreni Berg in Martius, *Fl. Bras.* 14(1):427. 1857. Type. Brazil. Minas Gerais:*Widgren* 548 (Holotype MEL)

B. affinis Berg in Martius, *Fl. Bras.* 14(1):605. 1859. Type. Brazil. Minas Gerais: 'In saxosis ferruginosus prope Inficionado' *Riedel* s. n. (Holotype LE n. v.)

B. parvifolius Berg in Martius, *Fl. Bras.* 14(1):606. 1859. Type. Brazil. Minas Gerais'In saxosis montis Serra da Piedade' *Riedel* s. n. (Holotype LE n. v.).

B. ramosissimus var. *obovatus* Berg in Martius, *Fl. Bras.* 14(1):606. 1859. Type. Brazil. Minas Gerais: 'In saxosis montis Serra da Piedade' *Riedel* s. n. (Holotype LE n. v.)

B. ramosissimus var. *nanus* Berg in Martius, *Fl. Bras.* 14(1):606. 1859. Type. Brazil. Minas Gerais: 'In saxosis ferruginosis momntium prope urbem Ouro Preto' *Riedel* s. n. (Holotype LE n. v.)

B. ramosissimus var. *latifolius* Berg in Martius, *Fl. Bras.* 14(1):606. 1859. Type. Brazil. Minas Gerais: 'In saxosis montis Serra da Piedade' *Riedel* s. n. (Holotype LE n. v.)

B. serra Berg in Martius, *Fl. Bras.* 14(1):605. 1859. Type. Brazil. Minas Gerais: 'In montis saxosis' *Riedel* s. n. (Holotype LE n. v.)

Myrtus apiculata (Berg) Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:17. 1893. **nov. syn.**

M. brunneus (Berg) Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:17. 1893. **nov. syn.**

M. longipes (Berg) Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:18. 1893. **nov. syn.**

M. reinhardtiana Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:18. 1893. nom. nov. for *Blepharocalyx canescens* Berg. **nov. syn.**

M. widgreni (Berg) Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:18. 1893. **nov. syn.**

Eugenia piedadensis Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:176. Tab. 21 fig. e. 1893. **nov. syn.**Type. Brazil. Minas Gerais: 'In regione alpina montis Serra da Piedade' *Warming* s. n. (Holotype C!)

E. ipehuensis Barb. Rodr. in Chodat et Hassler, *Bull. Herb. Boissier (Ser. 2)* 7:804. 1907. Type. Paraguay. 'In campo Ipé-hu Sierra de Maracayu' *Hassler* 5047; 'In silva pr. Igatimi' *Hassler* 4868 (Syntypes G n. v.)

Blepharocalyx gigantea Lillo, *Contr. Arb. Argent.* 67. 1910. *Anales Soc. Ci. Argent.* 72:174. 1911. Type. Argentina. Tucumán: Alpachiri, bosques de Haymes Hnos., 3 Jan 1910, *Venturi* 386 (Holotype LIL n. v.)

B. gigantea var. *montana* Lillo, *Anales Soc. Ci. Argent.* 72:174. 1911. Type. Argentina. Tucuman: Alpachiri, Potrerillo, bosque de Saturino Lobo, 3 Jan 1910, *Venturi* 406 (Holotype LIL n. v.)

B. deserti (Camb.) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:535. 1941.

B. mugiensis (Camb.) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:535. 1941.

B. suaveolens (Camb.) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:535. 1941.

B. umbilicata (Camb.) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:535. 1941.

B. suaveolens var. *umbillicatus* (Camb.) Legrand, *Notul. Syst.(Paris)* 15:272. 1958.

B. acuminatus var. *adamantium* (Camb.) Mattos, *Loefgrenia* 64:2. 1975.

B. minutiflorus Mattos & Legr., *Loefgrenia* 67:31. 1975. Type. Brazil. Paraná: Campina Grande do Sul, 28 Dec 1967, *Hatschbach* 18188 (Holotype MVM n. v.).

B. myrcianthoides Mattos, *Loefgrenia* 64:2. 1975. Type. Brazil. Rio Grande do Sul: Estrada São Borja-Santiago, 20 Dec 1973, *Lindeman & Irgang* s. n. (Holotype ICN n. v.).

B. tweediei var. *longipes* (Berg) Mattos, *Loefgrenia* 64:2. 1975.

B. tweediei var. *setentrionalis* Mattos, *Loefgrenia* 64:2. 1975. Type. Brazil. Paraná: João Eugenio, Rodeio, 28 Nov 1962, *Hatschbach* 9490 (Holotype MBM n. v.).

B. umbillicata var. *mugiensis* (Camb.) Mattos, *Loefgrenia* 64:2. 1975.

B. umbillicatus var. *paranaensis* Mattos, *Loefgrenia* 64:2. 1975. Type. Brazil. Paraná: Campina Grande do Sul Mandassaia, 24 Oct 1967, *Hatschbach* 17567 (Holotype MBM n. v.).

B. salicifolius var. *longipes* (Berg) Legr. in Legrand et Klein, *Fl. Illustr. Catarinense* : 785. 1978.

B. salicifolius var. *longipes* forma *catharinae* Legr. in Legrand & Klein, *Fl. Illustr. Catarinense* : 787. 1978. Type. Brazil. Santa Catarina: Pôrto União, Pintadinho, 800 m, 9 Dec 1962, *Klein* 3632 (Holotype MVM n. v.).

B. salicifolius var. *tweediei* (Hooker et Arnott) Legr. in Legrand et Klein, *Fl. Illustr. Catarinense* : 784. 1978.

B. suaveolens var. *abrupticulmen* Legr. in Legrand et Klein, *Fl. Illustr. Catarinense* : 795. 1978. Type. Brazil. Santa Catarina: Garuva, 900 m, 21 Dec 1960, *Reitz & Klein* 10430 (Holotype MVM n. v.).

B. suaveolens var. *cuneatus* Legr. in Legrand et Klein, *Fl. Illustr. Catarinense* : 797. 1978. Type. Brazil. Santa Catarina: Blumenau, Morro Spitzkopf, 950 m, 11 Mar 1960, *Klein* 2434 (Holotype MVM n. v.).

Tree to 15 m, predominantly glabrescent. **Hairs** simple, pale gray or yellowish, fine and appressed; young branchlets, petioles and leaves densely pubescent; axis of the inflorescence, bracts and floral buds glabrous or sparsely puberulous; inner surface of the petals puberulous. Branchlets with bark sometimes peeling in inconspicuous strings or irregular oblong strips. Mature **leaves** 1.5-8.9 x 0.5-3.8 cm., 1.3-4.2 times as long as wide, narrowly to widely

elliptic; base round, obtuse or acute; petiole 2-10 x ca. 0.5-1 mm. Cyme 1.4-5 cm. with 3, 7 or 15 **flowers** if no buds are aborted, rarely up to 31 or solitary flowers; bracts and bracteoles usually deciduous when the bud is very young but occasionally persisting until shortly after anthesis; peduncle 0.8-4.2 x 0.5(-1) mm; pedicels 0-10 mm; mature buds 4-7 x 3-5 mm, pear-shaped to capitate. Calyx lobes unequal, densely ciliate, strongly revolute and cuculate at anthesis, caducous after pollination; the outer pair 1-2 mm, widely triangular, obtuse; the inner pair 1.5-3 mm, circular to transverse-elliptic; hypanthium prolonged c. 0.5 mm below the staminal disk. Petals obovate to transverse-elliptic, 2.5-5 mm, densely ciliate. Staminal disk externally square, circular in the center. Stamens + 130-180, 5-11 mm.; anthers 0.25-0.5, gland-tipped. Ovary 1-2 mm; ovules 8-12, 3-6 per loculus; style 3.5-6 mm. **Berry** maturing bright red and then black, 4-7 mm.

Examined material - **Brazil. Distrito Federal:** Estação Florestal Cabeça do Veado, 13 Oct 1983, *Alves* 212 (HEPH); ibid., 9 Sep 1983, *Dutra* 2 (HEPH); ibid., 17 Dez 1983 (HEPH); ibid., 14 May 1984, *Dutra* 44 (HEPH); ibid., 14 May 1984, *Dutra* 45 (HEPH); ibid., 14 May 1984, *Dutra* 44 (HEPH); ibid., *Dutra* 46 (HEPH); Jardim Botânico de Brasília, 31 Oct 1985, *Equipe do JBB (Jardim Botânico de Brasília)* 604 (HEPH); ibid., 7 Oct 1986, *Equipe do JBB* 754 (HEPH); ibid., 15 Oct 1986, *Proença* 612 (HEPH); ibid., 24 Aug 1983, *Reis* 119 (HEPH); Setor de Indústrias, 9 Nov 1971, *Ferreira* 620 (HEPH); Próximo da UnB (Universidade de Brasília), 9 Nov 1971, *Ferreira* 624 (HEPH); ibid., 30 Sep 1971, *Filho* 5 (HEPH); Near Brasília Airport, 15 Oct 1976, *Ratter et al.* 3765 (UB); Parque Nacional de Brasília, Barragem de Sta. Maria, 9 Jun 1970, *Fonsêca* 1569 (UB); Near Brasília, E of the lake on the road to the prison, 6 Oct 1972, *Ratter, Fonsêca & Castro* 2593 (E, UB); Fazenda Agua Limpa, 3 Dez 1980, *Kirkbride* 1395 (UB); ibid., 7 May 1984, *Haridasan* 12 (UB); ibid., 7 May 1984, *Haridasan* 485 (UB); ibid., Oct 1980, *Paixão* 49 (UB); ibid., fl, 15 Oct 1976, *Ratter et al.* 3765 (UEC); ibid., 15 Oct 1976, *Ratter et al.* 3775 (UB); ibid., 24 Nov 1976, *Ratter et al.* 3977 (UEC); Próximo da Escola Fazendária, 15 Apr 1983, *Haridasan & Araújo* 195 (UB); Brasília, Plano Piloto, 20 Sep 1962, *Heringer* 8987 (UB); ibid., *Heringer* s. n. (UB); Horto do Guará, 25 Oct 1961, *Heringer* 8746 (UB); Parque do Guará, 20 Sep 1962, *Heringer* 8988 (HEPH, UB); Campus da UnB, *Heringer* 14849 (UB); ibid., 3 Aug 1981, *Nascimento & Silva* 7 (UB); ibid., 3 Oct 1978, *Taxonomy Class of the Universidade de Brasília* 635 (UB); Setor de Imprensa, 20 Sep 1963, *Heringer* 9185 (UB); Brasília, em frente ao Hospital Distrital, 30 Sep 1965, *Heringer* 10588

(UB); Terreno da Embaixada Britânica, 25 Oct 1975, *Heringer* 14860 (UB); Eixo Rodoviário da Asa Norte, 6 Sep 1963, *Cobra & Oliveira* 156 (UB); Reserva Biológica das Aguas Emendadas, 17 Jul 1984, *Proença* 391 (HEPH); Reserva Ecológica do IBGE, 18 Sep 1989, *Alvarenga & Oliveira* 423 (IBGE); ibid., 26 Sep 1989, *Alvarenga & Oliveira* 452 (IBGE); ibid., 26 Sep 1989, *Azevedo & Lopes* 337 (IBGE); ibid., 15 Dez 1986, *Proença* 667 (HEPH); Próximo ao Guará, 21 Sep 1972, *Silva* 49 (HEPH); Imediately S of Brasília, 8 Dez 1985, *Irwin et al.* 11123 (UB); Brasília, Lago Norte, 23 Oct 1978, *Taxonomy Class of the Universidade de Brasília* 634 (UB).

Vernacular names: Maria-Preta, Murtinha (Distrito Federal); Horco-Molle, Multa, Cocha-Molle, Anacuita, Arrayán (Argentina, Landrum 1986); Guamirim, Cambuí, Camboim, Legrand & Klein 1978).

Distribution - From Buenos Aires province in Argentina, both East and West of the Chaco, to Uruguay and Southern Brazil, extending north to the Distrito Federal and the Pico das Almas in the State of Bahia.

Discussion - An extremely variable taxon; the Distrito Federal form is a tree with relatively large, wide leaves (usually 2-4 times long as wide). This is a very common element in the area and one of the indicator species of nutrient-poor 'dystrophic cerradão' (Furley & Ratter 1988a) as opposed to 'mesotrophic cerradão'. It also occurs in cerrado sensu stricto.

Landrum (1986) drastically changed the species limits in *Blepharocalyx* , so that all the brazilian elements of the genus fall into one polymorphic species, in which the life form, shape of the leaves, degree of branching of the inflorescence and pubescence vary considerably although the actual flower structure is relatively uniform. Several nomenclatural synonyms that were overlooked by Landrum (1986) are proposed, based on Kiaerskov combinations (1893), and one new synonym based on a collection from Serra da Piedade in Minas Gerais with very young buds.

2. *Campomanesia* Ruiz & Pavon, *Fl. Peruv. prodr.* 72. pl. 13. 1794. Type. *C. lineatifolia* Ruiz & Pavon.

Syn.: *Abbevillea* Berg, *Linnaea* 27:349 (in clave), 425.1856. Lectotype: *A. klotzchiana* Berg, *Taxon* 5(6):136. 1956.

Acrandra Berg, *Linnaea* 27:349 (in clave), 435. 1856. Lectotype: *A. laurifolia* (Gardner) Berg, *Taxon* 5(6):137. 1956.

Britoa Berg, *Linnaea* 27:348 (in clave), 435. 1856. Lectotype: *B. sellowiana* Berg, *Taxon* 5(6):138. 1956.

Lacerdaea Berg, *Linnaea* 27:348 (in clave), 437. 1856. Type. *L. luschnathiana* Berg.

Paivaea Berg in Martius, *Fl. Bras.* 14(1):614. 1859. Type. *P. langsdorffii* Berg.

Campomanesia sect. *Abbevillea* (Berg) Niedenzu in Engl.& Prantl, *Nat. Pflanzenfam.* 3(7):73. 1893.

Campomanesia subgen. *Abbevillea* (Berg) Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:8. 1893.

Campomanesia subgen. *Acrandra* (Berg) Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:8. 1893.

Campomanesia sect. *Clausae* Mattos, *Loefgrenia* 26:22. 1967. Type. *C. guazumifolia* (Cambessèdes) Berg.

Campomanesia sect. *Apertae* Mattos *Loefgrenia* 26:22. 1967. Typus non designatus (invalid publication).

Campomanesia subsect. *Sessiliflorae* Mattos, *Loefgrenia* 26:26. 1967. Type. *C. sessiliflora* (Berg) Mattos.

Campomanesia subsect. *Pedunculatae* Mattos. *Loefgrenia* 26:28. 1967. Typus non designatus (invalid publication).

Trees, shrubs or perennial subshrubs woody at base or underground. Leaves not glandular-dotted against the light. Inflorescence a solitary, axillary flower, a 3-flowered dichasium or a highly modified axillary raceme in which the rachis continues vegetative growth and produces leaves under each bud so that it seems like a branch with a series of solitary, axillary flowers in later stages (precocious raceme). Bracts and bracteoles free. Buds open at the apex with anthesis ocurring by opening of the calyx lobes (Distrito Federal) or completely closed opening either by a calyptra or by longitudinal tearing of the hypanthium. Hypanthium prolonged above the level of insertion of the style or not. Calyx lobes when present 5, equal or slightly unequal. Petals 5, white. Anthers elliptic to narrow-oblong, 0.5-1.5 mm; loculi opening by straight, longitudinal slits which are parallel to the filaments. Ovary with 4-18 loculi; ovules 4-20 per loculus;

stigma pateliform. Berry usually yellow-green, yellow or orange, globose, with persistent calyx lobes or hypanthium remnants; pericarp somewhat thick. Seeds 0-1 per loculus, adnate to the externally verrucose loculi walls (pseudo-testa); true testa inconspicuous. Embryo with a large, coiled hypocotyl and free, relatively small cotyledons.

A neotropical genus with 26 species which grows throught continental South America except in Southern Argentina and Chile (Landrum 1986, 1987). The fruits have a high vitamin C content and are much appreciated by the local people.

Key to flowering material

1a Leaves glabrous or nearly so; flower buds glabrous or nearly so with conspicuous glandular dots.....2
1b Leaves various; flower buds strongly pubescent with obscure to hidden glandular dots.....3

2a Shrubs; mature buds 9-11 mm; pedicels 7-44 mm.....1. *C.adamantium*
2b Usually trees; mature buds 4-5 mm; pedicels 1-4 mm.....3. *C. eugenioides* var. *desertorum*

3a Pedicels 0-8 mm; petals puberulous on the outer surface; staminal disk sloped and circular; stamens more than 300.....5. *C. sessiliflora*
3b Pedicels 5-33 mm; petals glabrous; staminal disk flat and pentagonal; stamens less than150.....4

4a Mature leaves usually present at flowering; young leaves puberulous; calyx lobes slightly unequal; glandular dots on ovary usually visible through indumentum.....2. *C. aromatica*
4b Mature leaves usually deciduous before flowering; young leaves densely pubescent; calyx lobes equal; glandular dots on ovary not visible through indumentum.....5

5a Usually trees; mature buds 6-6.5 mm; calyx lobes (2-)3-5 mm.....6. *C. velutina*
5b Shrubs (Distrito Federal); mature buds 9-12 mm; calyx lobes (4-) 6-9 mm.....4. *C. pubescens*

Key to fruiting material

1a Young fruit glabrous or puberulous, mature fruit glabrous; fruiting calyx lobes glabrous and glandular-dotted without.....2
1b Young fruit pubescent, some pubescence persisting to maturity; fruiting calyx lobes usually pubescent without.....3

2a Trees or shrubs; bracteoles absent in the young fruit; mature fruit yellowish.....5
2b Shrubs; some bracteoles usually persisting in the young fruit; mature fruit 1.5-2 cm long, orange.....1.*C. adamantium*

3a Usually trees; barren pedicels (left after flower abortion) common in the young fruit stage; bracteoles usually absent in the young fruit.....6. *C. velutina*
3b Usually shrubs; barren pedicels rare in the young fruit stage; some bracteoles usually persistent in the young fruit.....4

4a Fruits usually tapering gradually towards the base when young, round when mature; pedicels usually exceeding 1 (rarely 0.2-1) cm.....4.*C. pubescens*
4b Young and mature fruits round; pedicels usually much shorter than 1 (rarely 0.8-1.2) cm.....5.*C. sessiliflora* var. *lanuginosa*

5a Mature fruit c. 0.6-1.3 cm (fide Landrum, 1986); fruit sepals equal, 1-2 mm.....3.*C. eugenioides* var. *fulvescens*
5b Mature fruit c. 1.5-2 cm; fruit sepals slightly unequal, 2.5-6 mm.....2. *C. aromatica*

Key to vegetative material

1a Trees or large shrubs in forests.....2
1b Shrubs in cerrado sensu lato.....3

2a Mature leaves c. 1-4 cm long, 1.7-2.4 times as long as wide.....3.*C. eugenioides* var. *desertorum*
2b Mature leaves c. 3.5-12 cm long, 2.3-4.2 times as long as wide.....6.*C. velutina*

3a New growth glabrous, rose or violet tinted when fresh.....1.*C. adamantium*
3b New growth puberulent to lanate, pale green when fresh.....4

4a New leaves puberulent; mature leaves with minute dark glandular dots on the underside.....2. *C. aromatica*
4b New leaves puberulent to lanuginous; mature leaves lacking glandular dots on the underside or these obscured by indumentum.....5

5a Mature leaves drying light brown to black above; hairs on the underside of the leaves sparser on the venation which appears as a dark network against the pale indumentum of surrounding leaf tissue.....
.....5.*C. sessiliflora* var. *lanuginosa*
5b Mature leaves drying light green to brown above; hairs on the underside of the leaves sometimes sparser on the midvein and lateral veins but not on the 3rd and 4th order venation which appears concolorous to surrounding leaf tissue.....4.*C. pubescens*

1. *Campomanesia adamantium* (Camb.) Berg, *Linnaea* 27:434. 1856. Based on

Psidium adamantium (**Fig. 3.27 & 4.4)**

Syn.: *Psidium adamantium* Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:292. 1833. Type. Brazil. Minas Gerais: 'Nascitur in parte provinciae dictâ Distrito dos diamantes' *Martius* s.n. (Holotype P n. v.)

P. campestre Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:289. 1833. Syntypes. Brazil. Minas Gerais: 'Haud infrequens in campis altis (vulgò Chapada) prope pagum S. Joaô et praedium dictum Fazenda do Capitaô Caetano Jozé de Mello in parte provinciae dicta Minas Novas' *St. Hilaire* s. n. (Holotype P n. v.)

Campomanesia cambessedeana Berg in Martius, *Fl. Bras.* 14(1):457. 1857. illeg. nom. nov. for *Psidium campestre* Camb.

C. glabra Berg in Martius, *Fl. Bras.* 14(1):450. 1857, non *C. glabra* Bentham, *J. Bot.* 2:319. 1840. nom. illeg.

C. obscura Berg in Martius, *Fl. Bras.* 14(1):451. 1857. Type. Brazil. São Paulo: 'Inter Carambey praedium et urbem Castro' *Sellow* s. n. (Holotype B, destroyed; Lectotype, Isotype at LE n. v., *Fl. Neotropica* 45:18. 1986)

C. caerulea Berg in Martius, *Fl. Bras.* 14(1):455. 1857. Syntypes: Brazil. Minas Gerais: *Claussen 517 & 622* ; São Paulo: 'prope villam Jundiahy et alibi in prov. ' *Sellow s. n.* (Lectotype, Isotype of *Claussen* 517 at BR n. v., *Fl. Neotropica* 45:18. 1986)

C. desertorum Berg in Martius, *Fl. Bras.* 14(1):450. 1857. Type. Brazil. Minas Gerais: 'In pascuis desertorum ad Arrayal Nossa Senhora do Padrocinio' *Pohl 449* (Holotype W n. v.)

?*Campomanesia vaccinioides* Berg in Martius, *Fl. Bras.* 14(1):450. 1857. Type. Brazil. São Paulo: 'Prope urbem prov. S. Pauli' *Sellow* s. n. (Holotype B - destroyed)

C. caerulescens Berg in Martius, *Fl. Bras.* 14(1):612. 1859. Type. Brazil. Mato Grosso: 'Prope Guardia do Diamantio' *Riedel* s. n. (Holotype LE n. v.)

C. resinosa Barbosa Rodrigues, *Myrt. Paraguay* 20. 1903. Type. Paraguay: 'Ipè-hú, in alto planitie et decliviis Sierra de Maracayú' *Hassler 5080* (Holotype G n. v.)

C. glareophila Barbosa Rodrigues ex Chodat et Hassler, *Bull. Herb. Boissier* 7:800. 1907. Type. Paraguay. 'In glareosis pr. Concepcion' *Hassler 7324* (Holotype G n. v.).

C. lancifolia Barbosa Rodrigues ex Chodat et Hassler, *Bull. Herb. Boissier* 7:800. 1907. Type. Paraguay. 'Pr. San Estanislao' *Hassler 4229 a* (Holotype G

n. v.)

C. paraguayensis Barbosa Rodrigues ex Chodat et Hassler, *Bull. Herb. Boissier* 7:800. 1907. Type. Paraguay. 'Pr. "Picada Isabel" Concepcion' *Hassler 7474* (Holotype G n. v.)

C. campestris (Cambessèdes) Legrand, *Notul. Syst.* 15(3):273. 1958.

C. cambessedeana var.*pyriformis* Mattos, *Loefgrenia* 32:1. 1969. Type. Brazil. São Paulo: Itararé, Campos de São Pedro, Fazenda Ventania, c. 1000 m, 17 Dec 1966, *Mattos* 14312 (Holotype SP n. v.)

Shrub or subshrub 0.1-1.2 m, almost completely glabrous. **Hairs** simple, fine; bracts with a reddish brown pubescence; inner surface of the calyx and staminal disc with a pale gray or yellowish puberulence. Branchlets with the bark sometimes spliting and peeling in irregular scrolls. Mature **leaves** 1.3-12.3 x 0.4-8.2 cm, usually obovate or narrowly-obovate but also narrowly-rhomboid to elliptic, 1.5-5 times as long as wide; apex abruptly acuminate, acute or obtuse, sometimes mucronate; base acute, obtuse, rounded or faintly cordate; petiole 1-12 x 1-2.5 mm. Precocious raceme 2.3-15 cm at anthesis (including young vegetative shoot), with 1-9 **flowers**; most bracts deciduous between anthesis and fruit initiation, very variable in shape, usually 1-11 mm but sometimes leafy; bracteoles usually deciduous between anthesis and fruit initiation, occasionally persistent in the mature fruit, 1.5-6 mm, linear, narrowly-rhomboid or obovate; pedicels 0.7-4.4 cm x 0.5-1 mm; mature buds 8-11 x 6-7 mm. Calyx lobes usually differing slightly from one another, c. 2-4 mm, triangular to semi-orbicular; outer calyx lobes smaller, obtuse, acuminate or rounded, sometimes with non-ciliate margins; inner calyx lobes larger, rounded, with ciliate margins; hypanthium not prolonged above style base level. Petals irregularly obovate, 6-11 mm, sometimes ciliate. Stamens ± 110-160, 5-11 mm; anthers oblong. Ovary 1.5-2 mm with 5-8 loculi; ovules ± 40-60, 6-9 ovules per loculus; style 6-10 mm. **Berry** pale orange, 1-2 cm.

Examined material - **Brazil. Distrito Federal:** Jardim Botânico de Brasília (Reserva Biológica), 24 Aug 1983, *Alves* 184 (HEPH); ibid., 12 Sep 1985, *Equipe do Jardim Botânico de Brasília* 590 (HEPH); ibid., 18 Sep 1984, *Proença* 417 (HEPH); Brasília, Campus da UnB (Universidade de Brasília), 20 Nov 1968, *Belém & Barroso* 3960 (UB); ibid., 20 Nov 1968, *Belém & Barroso* 3961 (UB); ibid., 20 Nov 1968, *Belém & Barroso* 3962 (UB); ibid., 20 Nov 1968, *Belém & Barroso* 3964 (UB); ibid., 20 Nov 1968, *Belém & Barroso* 3965 (UB); ibid., 20 Nov 1968,

Belém & Barroso 3967 (UB); ibid., 20 Nov 1968, *Belém & Barroso* 3975 (UB); ibid., 28 viii 1963, *Cobra & Oliveira* 23 (UB); ibid., *Cobra & Oliveira* 231 (UB); ibid., x-xi 1972, *Taxonomy Class of the Universidade de Brasília* 283 (UB); Fazenda Agua Limpa, 11 Oct 1979, *Taxonomy Class of the Universidade de Brasília* 713 (UB); ibid., 16 Sep 1976, *Heringer* 16209 (UB); Sobradinho, 9 Nov 1971, *Ferreira* 628 (HEPH); Reserva Biológica de Aguas Emendadas, 17 Nov 1971, *Ferreira* 1015 (HEPH); Rio São Bartolomeu, 2 Sep 1961, *Heringer* 8675 (UB); Parque do Guará, 10 Oct 1962, *Heringer* 9027 (UB); Catetinho, 2 Oct 1973, *Heringer* 12906 (UB); ibid., *Heringer* 12907 (IBGE, UB); Brasília, Sede do IBDF, 21 Sep 1976, *Heringer* 16246 [mixed collection] (UB); RECOR, 500m do Lago Paranoá, 9 Nov 1978, *Heringer et al.* 698 (IBGE); Parque Nacional de Brasília, 18 Aug 1964, *Heringer & Belém* 9775 (UB); Reserva Ecológica do IBGE, 1 Sep 1983, *Pereira* 720 (IBGE); ibid., 25 Nov 1986, *Proença* 658 (HEPH); ibid., 19 Sep 1989, *Alvarenga & Lopes* 449 (IBGE); ibid., 18 Sep 1989, *Alvarenga & Oliveira* 421 (IBGE); ibid., 26 Sep 1989, *Azevedo & Lopes* 335 (IBGE); ibid., 5 Sep 1989, *Silva & Lopes* 821 (IBGE); Rio Melchior, 20 km S de Brasília na Estrada entre Brasília e Goiânia,fr, 25 Sep 1965, *Irwin, Souza & Santos* 8462 (UB); 5 km N de Planaltina na Estrada para S. Gabriel de Goiás, 16 Oct 1965, *Irwin, Souza & Santos* 9267 (UB); 32 km SW de Brasília on road to Anápolis, 4 Sep 1964, *Irwin & Soderstrom* 5997 (UB); Escola Fazendária, 6 Nov 1981, *Heringer* 18229 (IBGE); ibid., 3 Dez 1981, *Heringer* 18248 (IBGE). **Goiás:** Padre Bernardo, 15° 30' S, 48° 35' W, 21 Sep 1972, *Ratter, Fonsêca & Castro* 2441 (E, UB). **Minas Gerais:** Paracatú, Fazenda Acangaú, 13 Dez 1988, *Filgueiras & Alvarenga* 1600 (IBGE); fl, 1840, *Gardner* 4684 (E).

Vernacular name - Guabiroba-do-Campo (Landrum 1986).

Distribution - A relatively common species in the Distrito Federal cited by collectors as occurring in grassy or gravely savanna and dry or dense savanna woodland. It also grows in Paraguay and in the Brazilian States of Mato Grosso do Sul, Goiás, Minas Gerais, São Paulo, Paraná and Santa Catarina.

2. ***Campomanesia aromatica*** (Aublet) Griseb.,*Fl. Brit. W. I.* 242. 1860.(**Fig. 3.28)**

Syn.: *Psidium aromaticum* Aublet, *Hist. Pl. Guiane* 485. 1775. Type. French Guyana: 'Habitat in sylvis Caiennae & Guianae' *Aublet* s. n. (Holotype BM n. v.)

Myrtus psidioides Hamilton, *Prodr. Pl. Ind. Occid.* 44. 1825. later homonym.

Psidium tenuifolium A. P. de Candolle, *Prodr.* 3:236. 1828. Type. Brazil.'In Bahia desertis' *Martius* s. n. (Holotype M n. v.)

Myrtus fascicularis A. P. de Candolle, *Prodr.* 3:240. 1828. Type. 'In Cayenna'. (Holotype G-DC n. v.)

Eugenia sparsiflora A. P. de Candolle, *Prodr.* 3:263. 1828. Type: Brazil. 'Prope Almada prov. Bahiensis' *Martius* s. n. (Holotype M n. v.)

E. desvauxiana Berg, *Linnaea* 27:198. 1956. nom. nov. for *Myrtus psidioides* Hamilton.

Campomanesia synchrona Berg in Martius, *Fl. Bras.* 14(1):444. 1857. Type. Brazil.'Ad urbem Jacobina in prov. Bahiensi (v. in hb. Berol. et Vindob.)' *Blanchet* 3367 (Lectotype, Syntype at W n. v. *Fl. Neotropica* 45:21. 1986)

C. coaetenea Berg in Martius, *Fl. Bras.* 14(1):444. 1857. Type. Guyana. 'In Guyana Anglica ad flumen Tacutu (v. in hb. Berol. et Vindob.)' *Rich. Schomburgk* 528 & *Rob. Schomburgk* 311 (Lectotype, *Schomburgk* 311 at W; Paratype, *Schomburgk* 528 at LE); 'in Brasilia aequatoriali' (Paratype F n. v.)

C. ciliata Berg in Martius, *Fl. Bras.* 14(1):453. 1857. Type. Brazil. 'Ante Quartel Teixeira in prov. Pernambuco' *Pohl* 1052 (Holotype B - destroyed; Lectotype, Isotype at W n. v., *Fl. Neotropica* 45:21. 1986)

C. tenuifolia (A. P. de Candolle) Berg in Martius, *Fl. Bras.* 14(1):452. 1857.

Abbevillea martiana Berg in Martius, *Fl. Bras.* 14(1):435. 1857. Nomenclatural later synonym of *Eugenia sparsiflora* DC.

Campomanesia glazioviana Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:16. 1893. Type. Brazil. *Glaziou* 12729 (Holotype C n. v.)

C. beaurepairiana Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:15. 1893. Type. Brazil. *Glaziou 11980* (Holotype C n. v.)

Shrub 0.4-1.2 m. **Hairs** simple, whitish, twisted, very short and fine; branchlets, petioles and leaves puberulent when young becoming sparsely so to glabrous when mature; pedicels, bracts, bracteoles and outer surface of the calyx sparsely puberulous to nearly glabrous; ovary and inner surface of the calyx densely puberulent; staminal disk pubescent except sometimes at the style base. Branchlets with the bark spliting and peeling as fruit matures. Mature **leaves** 2-11 x 0.6-4.2 cm, narrowly-oblanceolate, narrowly-elliptic or obovate , 1.8-5.7 times as long as wide; apex usually acute or slightly acuminate, rarely obtuse, sometimes mucronate; base acute, obtuse or abruptly subcordate; petiole

2-6 x 0.5-2 mm. Precocious raceme 2.5-17 cm at anthesis (including vegetative shoot), with 1-5 **flowers**; bracts deciduous after fruit initiation, triangular to narrow-elliptic, usually 2-8 mm but rarely leafy; pedicels 8-32 x 0.5-1 mm; bracteoles deciduous after fruit initiation, 3-6 mm, linear; mature bud 9-11 x c. 7 mm, pear-shaped. Calyx lobes subequal, triangular, acute or obtuse, densely ciliate, or sometimes the inner calyx lobes rounded; hypanthium not prolonged above style insertion level. Petals 6-9 mm, sparsely ciliate. Staminal disk 3-5 mm, flat, pentagonal; stamens ± 90-110, 3-5 mm; anthers oblong to elliptic. Style 6-7.5 mm; ovary c. 2 mm with 5-7 loculi; ovules ± 30-75, 5-12 per loculus. **Berry** yellowish (fide *Felfili et al.* 103), c. 1.5-2.5 cm.

Examined material - **Brazil. Distrito Federal:** Saída para Anápolis, bud, 10 Dez 1965, *Belém* 1934 (UB); Brasília, 11 Sep 1973, *Heringer* 12911 (UEC); Campus da UnB, 20 Nov 68, *Belém & Barroso* 3957 (UB); Asa Norte, 10 Dez 1968, *Belém & Barroso* 4023 (UB); Reserva Biológica das Aguas Emendadas, 17 Nov 1971, *Ferreira* 1015 (HEPH); Fazenda Agua Limpa, 16 Sep 1978, *Ferreira* s. n. (UB); Catetinho, 20 Oct 1973, *Heringer* 12806 (IBGE); Sede do IBDF, 21 Sep 1976, *Heringer* 16253 (IBGE); Campus da UnB, 28 Dez 1975; *Heringer* 15405 (IBGE, UB); Sede do IBDF, 11 Sep 1976, *Heringer* 16253 (UB); Chapada da Contagem, c. 30 km NE of Brasília, 19 Sep 1965, *Irwin et al.* 8467 (UB); Fazenda Agua Limpa, 11 Sep 1984, *Proença* 405 (UB). **Minas Gerais:** Aug(1839?)-Apr 1840, *Claussen* s. n. (F); Patrocíneo, 14 Nov 1988, *Felfili et al.* 1 (IBGE); ibid., 15 Nov 1988, *Felfili et al.* 49 (IBGE); Entre Patrocíneo e Coromandel, 16 Nov 1988, *Felfili et al.* 103 (IBGE).

Vernacular names - Guabiroba-do-Cerrado (São Paulo). Collectors cite the habitat of this species as being savanna woodland, sometimes commenting that it is in an open, recently burned formation.

Distribution - *Campomanesia aromatica* is usually a small savanna tree that grows in the Guyana Highlands, Bolivia and Coastal Bahia (Landrum 1986).

Discussion - This species had not been previously recorded from the Distrito Federal. All the Distrito Federal collections are of shrubs but I have also examined three collections from Patrocíneo in Northwestern Minas Gerais, one of which is of a tree and the other two of shrubs. Landrum (1986) states that *C.*

xanthocarpa (which grows in the cool south Brazilian forests) and *C. aromatica* may well form the ends of a cline, but does not unite them due to their distinct phytogeographical affinities. The Patrocíneo and Distrito Federal material reduces the morphological differences (and narrows the geographic disjuction) between these two species. I suspect that they will eventually have to be united as more material from poorly-collected Central Brazil acumulates.

3. *C. eugenioides* (Camb.) Legrand var. *desertorum* (DC.) Landrum, *Brittonia* 36(3):241. 1984. (**Fig. 3.29**)

Syn.: *Psidium desertorum* DC., *Prodr.* 3:236. 1828. Type. Brazil. Bahia: 'Ad desertum' *Martius* s. n. (Lectotype, Isotype at M n. v.)

Campomanesia repanda Berg in Martius, *Fl. Bras.* 14(1):456. 1857. nom. nov. illeg. for *Psidium desertorum* DC.

C. dardanolimai Mattos & Legr., *Loefgrenia* 67:10. 1975. Type. Brazil. Pernambuco: *D. A. Lima* 704 (Holotype MVM n. v.)

Tree to 8 m, predominantly glabrescent. **Hairs** simple, pale grey, fine; brachlets, petioles and leaves puberulent when young becoming glabrescent with age; pedicels, bracts and bracteoles puberulent; ovary and inner surface of sepals sometimes sparsely puberulent. Branchlets with bark sometimes peeling 2- or 3-fold in irregular oblongs. Mature **leaves** 1.2-3.9 x 0.7-1.1 cm, elliptic or ovate, 1.7-2.4 times as long as wide; apex acute or acuminate; base obtuse, acute or rounded; petiole 3-11 mm x ca. 0.5 mm. Precocious raceme 1.2-7.2 cm at anthesis (including young vegetative shoot) with 1-5 **flowers**; bracts rare, persistent, triangular, ca. 1 mm; bracteoles deciduous in the young bud or rarely persistent until anthesis, linear, c. 1.5 mm; pedicels 1-4 mm x ca. 0.5 mm; mature bud 4-5 x c. 3 mm, club-shaped, glandular. Calyx lobes subequal, widely triangular, obtuse or the inner ones rounded, ciliate; hypanthium cup prolonged at and above the staminal disk c. 0.5 mm. Petals 2-6 mm. Staminal disk 2-2.5 mm, circular, sloped towards the flat stylar base, pubescent; stamens 70-90, 3-4 mm; anthers widely-elliptic. Style 5-5.5 mm; ovary c. 1 mm with 3-5 loculi; ovules ± 20-30, 5-8 ovules per loculus. **Berry** yellow (fide Landrum 1986), 0.6-1.3 cm.

Examined material - **Brazil. Distrito Federal:** Catetinho, 2 Oct 1973,

Heringer 12890 (IBGE, UB, UEC); ibid., 26 Oct 1975, *Heringer* 14870 (IBGE, UB) ibid., 18 Oct 1980, *Heringer* 17949 (IBGE); FERCAL, *Ramos* s. n. (UB).

Distribution & Discussion - The specimens I have examined appear to belong to var. *desertorum,* although there is some gradation towards var. *eugenioides,* especially in leaf shape. This is perhaps to be expected since var. *desertorum* grows from the Distrito Federal northwards in the States of Goiás, Tocantins and Bahia, while var. *eugenioides* grows roughly southwards of the Distrito Federal in Goiás, Minas Gerais, Mato Grosso do Sul, São Paulo and Paraná. Landrum (1986) cites a specimen of var. *eugenioides* from nearby Serra do Rio Preto in Goiás, so perhaps this variety also occurrs in the Distrito Federal. The leaves of var. *eugenioides* are sometimes glabrous even when young and larger at maturity than those of var. *desertorum*. A rare species in the Distrito Federal which seems to prefer rich, calcareous soils.

4. ***Campomanesia pubescens*** (DC.) Berg, *Linnaea* 27:429.1856. Based on *Psidium pubescens.* **(Fig. 3.30)**

Syn.: *Psidium pubescens* DC., *Prodr.* 3:234.1828. Type. Brazil. Pernambuco: 'Campis versus flumen Termo' *Martius* s. n. (Holotype M n. v.)

?*P. hians* DC., *Prodr.* 3:234.1828. Type. Brazil: 'Ad Vao do Parana in Tabuleiro et Catingas' *Martius* s. n. (Holotype M n. v.)

P. erianthum Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:279.1833. Type. Brazil. Minas Gerais: 'Prope praedium Itajuru de S. Miguel do Mato dentro' *St. Hilaire* s. n. (Holotype P n. v.)

P. corymbosum Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:286.1833. Type. Brazil. Minas Gerais: 'Frequens in campis altis' *St. Hilaire* s. n. (Holotype P n. v.).

P. multiflorum Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:287 non 281.1833. **nov. syn.** Type. Brazil. Minas Gerais: 'In parte deserta occidentalique provinciae dicta Certão prope vicum Formigas' *St. Hilaire* s. n. (Holotype P n. v.)

P. suaveolens Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:291.1833. Type. Brazil. Minas Gerais: 'In sylvis prope vicum Congonhas do Campo' *St. Hilaire* s. n. (Holotype P n. v.)

P. obversum Miquel, *Linnaea* 22:532. 1849. Type. Brazil. Minas Gerais?: *Regnell* 1-125 c (Holotype U n. v.)

P. erosum Miquel, *Linnaea* 22:533. 1849. Type. Brazil. Minas Gerais?: *Regnell* 2-117 (Holotype U n. v.)

P. corymbosum forma *angustifolia* Miquel, *Linnaea* 22:532. 1849. Type. Brazil. *Regnell* 1-125 b (Holotype U n. v.).

Britoa eriantha (Cambessèdes) Berg, *Linnaea* 27:436. 1856.

Campomanesia suaveolens (Camb.) Berg, *Linnaea* 27:434. 1856.

C. corymbosa (Camb.) Berg, *Linnaea* 27:429. 1856.

C. obversa (Miquel) Berg, *Linnaea* 27:430. 1856.

C. reticulata Berg in Martius, *Fl. Bras.* 14(1):439.1857. Type. Brazil. Minas Gerais: *Widgren* s. n. (Syntype MEL); São Paulo: 'Ypanema' *Sellow* s. n. (Syntype probably B - destroyed).

C. rugosa Berg in Martius, *Fl. Bras.* 14(1):439.1857. Type. Brazil. Minas Gerais: 'Juxta rivum prope Borda do Campo' *Pohl* 227 (Holotype W n. v.).

C. discolor Berg in Martius, *Fl. Bras.* 14(1):439.1857. Type. Brazil. *Sellow* s. n. (Holotype B - destroyed, Lectotype, Isotype at K n. v.)

C. discolor var. *alternifolia* Berg in Martius, *Fl. Bras.* 14(1):440.1857. nom. illeg. for var. *discolor.*

C. discolor var. *oppositifolia* Berg in Martius, *Fl. Bras.* 14(1):440.1857. Type. Brazil. São Paulo: 'Nascitur in campis prope praedium vulgo Fazenda da Caxambu in parte prov. dicta Campos Geraës' *Sellow* s. n. (Holotype B - destroyed, Lectotype, Isotype at BR n. v., *Fl. Neotropica* 45:50. 1986)

?*C. australis* Berg in Martius, *Fl. Bras.* 14(1):445.1857. Type. Brazil. Rio Grande do Sul: 'In campis ad Paula Grassa prov.' *Sellow* s. n. (Holotype B - destroyed)

C. heterophylla Berg in Martius, Fl. Bras. 14(1):440.1857. Type. Brazil. Minas Gerais: 'In campis prope Cachambú' *Widgren* 534 1/2 (Syntype B - destroyed, Lectotype, Syntype at MEL, *Fl. Neotropica* 45:50. 1986)

C. campestris Berg in Martius, *Fl. Bras.* 14(1):440. 1857. Type. Brazil. Minas Gerais: 'ad Coche d'Agoa prope urbem Cidade de Ouro preto' *Martius* 33 (Lectotype, Syntype at M n. v., *Fl. Neotropica* 45:50. 1986), 'in Serra do Lenheiro prope urbem S. Joâo del Rey' *Sellow* s. n. (Paratype, Syntype at K!, *Fl. Neotropica* 45:50. 1986)

C. *pohliana* Berg in Martius, *Fl. Bras.* 14(1):441. 1857. Type. Brazil. 'Habitat ad Batalha, Registro velho et Fanado' *Pohl* 1055 (Syntype B - destroyed, Lectotype, Syntype at W n. v., *Fl. Neotropica* 45:51. 1986)

C. *pubescens* var. *coarcta* Berg in Martius, *Fl. Bras.* 14(1):443. 1857. Type. Brazil. nom. illeg. for var. *pubescens.*

C. *pubescens* var. *effusa* Berg in Martius, *Fl. Bras.* 14(1):443. 1857. Type. Brazil. *Martius* s. n. (Holotype MEL n. v.)

C. *salviaefolia* Berg in Martius, *Fl. Bras.* 14(1):442. 1857. Type. Brazil. 'V. in hb. Mart. ex coll. St. Hil. sub nomine Myrciae'[*Ackermann* s. n.] (Lectotype, Isotype at BR n. v., *Fl. Neotropica* 45:51. 1986)

C. *salviaefolia* var. *latifolia* Berg in Martius, *Fl. Bras.* 14(1):442. 1857. nom. illeg. for var. *salviaefolia.*

C. *salviaefolia* var. *angustifolia* (Miquel) Berg in Martius, *Fl. Bras.* 14(1):442. 1857.

C. multiflora (Camb.) Berg, Fl. Bras. 14(1):443. 1857. **nov. syn.**

C. *affinis* Berg in Martius, *Fl. Bras.* 14(1):446. 1857. Type. Brazil. Minas Gerais:'Ad Congonhas do Campo' *Stephan* s. n. (Lectotype, Syntype at BR n. v., *Fl. Neotropica* 45:51. 1986); São Paulo, Paraná: 'Prope Ypanema et S. Paulo in prov. S. Pauli et ad S. Ignacio in prov. Paraná' *Sellow* s. n. (Paratype K!, L ,W, *Fl. Neotropica* 45:51. 1986)

C. cuneata Berg in Martius, *Fl. Bras.* 14(1):446. 1857. Type. Brazil. Minas Gerais: 'In campis' *Sellow* s. n. (Holotype B - destroyed; Lectotype, Isotype at K!, *Fl. Neotropica* 45:51. 1986)

C. fusca Berg in Martius, *Fl. Bras.* 14(1):447. 1857. nom. illeg.

C. fusca var. *erosum* (Miquel) Berg in Martius, *Fl. Bras.* 14(1):447. 1857.

C. fusca var. *integra* Berg in Martius, *Fl. Bras.* 14(1):447. 1857. Type. Brazil. *Sellow* s. n. (Holotype B - destroyed, Lectotype, Isotype at K!)

C. fusca var. *stricta* Berg in Martius, *Fl. Bras.* 14(1):448. 1857. Type. Brazil. 'Ad Registro Velho' *Pohl* 157 (Holotype W n. v.)

C. fusca var. *subtriflora* Berg in Martius, *Fl. Bras.* 14(1):448. 1857. Type. Brazil. *Regnell* 1-128 (Holotype MEL n. v.)

C. widgreniana Berg in Martius, *Fl. Bras.* 14(1):447. 1857. Type. Brazil. 'In prov. Minarum' *Widgren* 531 (Holotype MEL n. v.)

C. houlletti Berg in Martius, *Fl. Bras.* 14(1):449. 1857. Type. Brazil. Rio de Janeiro: *Houllet* s. n. (Lectotype, Syntype at BR n. v., *Fl. Neotropica* 45:51. 1986); Minas Gerais: *Claussen* 309 (Paratype, *Fl. Neotropica* 45:51. 1986)

C. ovalifolia Berg in Martius, *Fl. Bras.* 14(1):452. 1857. Type. Brazil. Sao Paulo:'Prope urbem Castro' *Sellow* s. n. (Holotype B - destroyed)

C. obversa var. *latifolia* Berg in Martius, *Fl. Bras.* 14(1):445.1857. Type. Brazil. Minas Gerais:[erroneously cited as *Regnell I 125 c*] *Widgren 530* (Lectotype, Syntype at MEL, *Fl. Neotropica* 45:51. 1986); Minas Gerais: *Sellow* s. n. (Paratype K!, Fl. Neotropica 45:51. 1986)

C. obversa var. b *angustifolia* Berg in Martius, *Fl. Bras.* 14(1):446.1857. Type. Brazil. Minas Gerais: 'Ad Caldas'[erroneously cited as *Sellow s. n.* & *Widgren* 530] *Regnell* 1-125 c (Lectotype, Annotated specimen at MEL, *Fl. Neotropica* 45:51. 1986)

C. obversa var. *perforata* Berg in Martius, *Fl. Bras.* 14(1):446.1857. Type. Brazil. Minas Gerais: 'Ad Congonhas do Campo' *Stephan* s. n. (Holotype BR n. v.)

C. rhytidophylla Berg in Martius, *Fl. Bras.* 14(1):608.1859. Type. Brazil. São Paulo: 'Prope oppidum Villa Franca' *Riedel* s. n. (Holotype LE n. v.)

C. dimorpha Berg in Martius, *Fl. Bras.* 14(1):609.1859. Type. Brazil. São Paulo: 'In campis prope S. Carlos' *Riedel* s. n. (Holotype LE n. v.)

C. ovalifolia var. *venulosa* Berg in Martius, *Fl. Bras.* 14(1):611.1859. Type. Brazil. 'Prope Paranna' *Riedel* s. n. (Holotype LE n. v.)

C. virescens Berg in Martius, *Fl. Bras.* 14(1):611.1859. Type. Brazil. Minas Gerais: 'Prope Paracatu' *Riedel s. n.* (Holotype LE n. v.)

C. lanceolata Berg in Martius, *Fl. Bras.* 14(1):612.1859. Type. Brazil. Minas Gerais: 'Prope amnes Rio das Velhas et Parahiba' *Riedel s. n.* (Holotype LE n. v.)

C. bracteolata Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:14. 1893. Type. Brazil. Minas Gerais: 'Ad Lagoa Santa' *Warming* 1038 (Holotype C n. v.)

C. warmingiana Kiaerskou in Warming, *Symb. Fl. Bras. Centr.* 39:10. 1893. Type. Brazil. Minas Gerais: 'Ad Lagoa Santa' *Warming s. n.* (Lectotype C n. v., *Fl. Neotropica* 45:52. 1986)

C. diversifolia Barbosa Rodrigues, *Myrt. Paraguay* 18. 1903. Type. Paraguay: 'Ad regione vicine Igatemy' *Hassler* 4799 (Holotype G n. v.)

C. hassleri Barbosa Rodrigues, *Myrt. Paraguay* 19. 1903. Type. Paraguay: 'Prope Igatemy'*Hassler* 4858 (Holotype G n. v.)

C. trichosepala Barbosa Rodrigues, *Myrt. Paraguay* 18. 1903. Type. Paraguay: 'Regione vicine Igatemy' *Hassler* 4774 (Holotype G n. v.)

C. apiculata Barbosa Rodrigues ex Chodat et Hassler, Bull. Herb. Boissier 7:800. 1907. Type. Paraguay: 'Ipéhu, Sierra de Maracayu' *Hassler* 4947 (Holotype G n. v.)

C. yerutiensis Barbosa Rodrigues ex Chodat et Hassler, *Bull. Herb. Boissier (Ser 2)* 7:800. 1907. Type. Paraguay: 'In campo Yeruti' *Hassler* 5790 (Holotype G n. v.)

C. gomesiana Handro et Mattos, *Loefgrenia* 25:1. 1967. Type. Brazil. Mato Grosso: Tres Lagoas, 19 Oct 1964, *J. Correa Gomes Jr.* 2347 (Holotype SP n. v.)

C. eriantha (Camb.) Blume ex Mattos, *Loefgrenia* 26:33. 1967.

Shrub or subshrub 0.3-1.5 m. **Hairs** simple, usually cream to pale ochre, fine and twisted; bracts only with a reddish-brown pubescence; branchlets, petioles and upper surface of the leaves pubescent when young, the shoots and under surface of the leaves lanuginous when young, all vegetative parts glabrous to sparsely pubescent at maturity; bracteoles, calyx and young fruit pubescent; pedicels, staminal disk and ovary densely pubescent; corola and style glabrous. Branchlets peeling in irregular scrolls after flowering. Mature **leaves** rarely alternate, 4.5-10.5 x 1-4.8 cm, usually obovate or narrowly-obovate but also ovate or elliptic, 1.5-6.6 times as long as wide; apex acute to round, usually mucronate; base obtuse, cordate or acute; petiole 1-6 x 1-2 mm. Precocious raceme 3-16 cm at anthesis (including young vegetative shoot), very rarely a dichasium, with 1-7 **flowers**; some bracts and bracteoles usually persistent in the young fruit; bracts triangular to narrowly elliptic, 3-16 mm; bracteoles linear, 5-16 mm; pedicels 1-2.6 cm x 0.5-1.5 mm; mature buds 9-12 x 7-8 mm, obovate. Calyx lobes usually equal, c. 4-7 mm, narrow-triangular; hypanthium not prolonged above style base level. Petals 6-10 mm, somewhat ciliate. Stamens ± 90-130, 5-9 mm. Ovary 2-4 mm with 5-8 loculi; ovules ± 25-80, 5-12 per loculus; style 6-9 mm. **Berry** yellow-green to pale yellowish-white, 1-2 cm; seeds 1-5, orange, verrucose, reniform, c. 5 x 5 mm.

Examined material - **Brazil. Distrito Federal:** Jardim Botânico de Brasília, 27 Apr 1983, *Alves* 122 (HEPH); ibid., 24 Oct 1986, *Proença* 637 (HEPH); ibid., 30 Oct 1986, *Proença* 644 (HEPH); ibid., 27 Oct 1988, *Proença* 697 (HEPH); Fazenda Agua Limpa, 20 Sep 1979, *Cesar* 704 (UB); ibid., '28 Aug 1979', *Cesar* 708 (UB); ibid., 20 Sep 1979, *Cesar* 709 (E); ibid., Apr 1983, *Haridasan* 148 (UB); ibid., 23 Apr 1984, *Haridasan & Batmanian* 440 (UB); ibid., 4 Dez 1978, *Ratter & Fonsêca Filho* 4348 (E); ibid., 21 Sep 1976, *Ratter et al.* 3627 (E, UB); ibid., *Teresa* s. n. (UB); Brasília, Campus da UnB (Universidade de Brasília), 28 Aug 1963, *Cobra & Oliveira* 52 (UB); ibid., 6 Nov 1973, *Heringer* 12911 (IBGE); ibid., *Taxonomy Class of the Universidade de Brasília* 707 (UB); Brasília, Lago Norte, 23 Sep 1963, *Cobra & Oliveira* 239 (UB); ibid., 14 Sep 1982, *Heringer et al.* 7520 (IBGE); Parque do Guará, 20 Sep 1962, *Heringer* 8976 (IBGE, UB); Brasília, área da sede do IBDF (Instituto Brasileiro de Desenvolvimento Florestal), 21 Sep 1976, *Heringer* 16252 (UB); Entre a Reserva (Ecológica do IBGE) e o DNER, 20 Nov 1978, *Heringer* 17181 (IBGE); Brasília, Estação de Biologia, UnB, 9 Nov 1981, *Heringer*

18225 (UB); Escola Fazendária, 3 Dez 1981, *Heringer* 18250 (IBGE); Brasília, Península Norte,, 6 Sep 1982, *Heringer* 18250 (IBGE); ibid., 20 Oct 1982, *Heringer* 18606 (IBGE); Parque Nacional de Brasília, 18 Aug 1964, *Heringer & Belém* 9774 (UB); Córrego Quilombo, 18 Sep 1980, *Heringer et al.* 5511 (IBGE); Bacia do Rio São Bartolomeu, 17 Nov 1980, *Heringer et al.* 5756 (IBGE); Lago Paranoá, 11 Dez 1965, *Irwin et al.* 11216 (UB); FERCAL, 19 Sep 1964, *Prance & Silva* 59067 (UB); Reserva Ecológica do IBGE, 25 Nov 1986, *Proença* 657 (HEPH); ibid., 11 Oct 1978, *Heringer et al.* 650 (IBGE); ibid., 20 Sep 1979, *Heringer et al.* 2025 (IBGE); ibid., 30 Oct 1986, *Silva 206* (IBGE); Caminho para Cachoeira do Itororó, *Proença* s. n. (HEPH); Jockey Club de Brasília, 31 Oct 1972, *Silva* 68 (HEPH). **Minas Gerais:** Oct (1839?)-Apr 1840, *Claussen* s. n.(F). **Goiás:** Luziânia, 15 Dez 1980, *Heringer* 18000 (IBGE).

Vernacular names - Guabiroba or Gabiroba (Distrito Federal).

Distribution - In my experience this is the most commonly encountered species of *Campomanesia* in the Distrito Federal. It is particularly abundant in the open kinds of savana. Ratter et al. (1988) found it to be 20th dominant species in a 'low campo sujo or cerrado' in the State of São Paulo. It also grows in Paraguay and in the Brazilian States of Bahia, Minas Gerais, Goiás, Mato Grosso and Mato Grosso do Sul.

Discussion - This is another wide-spread and common cerrado species which, in the recent revision by Landrum (1986), has acquired a vast synonymy. A strong factor in this case is the great differences in leaf shapes, and the transformation that occurs between the young bud stage, where only the softly velutinous new growth is present, to the mature fruiting plants which have coriaceous, glabrous leaves in which the veins are markedly raised below.

Psidium multiflorum was transferred to *Campomanesia* by Berg, but was subsequently excluded from the genus by Landrum (1986) who noted that he had seen the 'specimen at P...assumed to be the holotype...belongs to *C. pubescens* but is probably not the type. The description and illustration of *P. multiflorum* indicates that it is a true *Psidium*.' Landrum was apparently unaware of the fact that Cambessèdes used this name twice, once on page 281 and once on page 287 of the *Flora Brasiliensis Meridionalis:* both species were described, but only the one on pg. 281 was illustrated. Berg (1857) was clearly aware of this, and retained *P. multiflorum* pg. 281 in *Psidium* while transfering *P. multiflorum*

pg. 287 to *Campomanesia.* We may therefore assume that the illustration seen by Landrum belonged to *P. multiflorum* pg. 281, while the specimen he examined at P was indeed the type of *Psidium multiflorum* pg. 287, whose description 'germen 5-loculare, loculis 8-ovulatis, etc.' matches *C. pubescens* perfectly.

P. multiflorum Camb. pg. 287 has therefore been included in the synonymy as a rejected homonym in accordance to Berg's choice to apply that name to *P. multiflorum* pg. 281.

5. *Campomanesia sessiliflora* (Berg) Mattos var. ***lanuginosa*** (Barb. Rodr. ex Chodat & Hassler) Landrum, *Brittonia* 36(3):241. 1984. (**Fig. 3.31**)

Syn.:*Campomanesia langsdorffii* Berg in Martius, *Fl. Bras.* 14(1):610.1859. Type. Brazil. Mato Grosso: 'In campis prope Guardia do Diamantino' *Riedel* s. n. (Holotype LE n. v.)

Campomanesia rugosa var. *lanuginosa* Barbosa Rodrigues ex Chodat et Hassler, *Bull. Herb. Boissier* 7:800. 1907. Type. Paraguay: 'In campo ad ripam fluminis Aquidaban pr. Concepción' *Hassler* 7678 (Holotype G n. v.)

C. mollicarpa Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier* 7:800. 1907. Type. Paraguay. 'In campis siccis in regione cursus superioris fluminis Apa' *Hassler* 7737 (Holotype G n. v.)

C. apaensis Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier (Ser 2)* 7:800. 1907. Type. Paraguay. 'In campis glareosis in regione cursus superioris fluminis Apa' *Hassler* 7827 (Holotype G n. v.)

Shrubs to 0.5 m, predominatly pubescent; hairs simple, pale silver grey or cream, fine and twisted. Branchlets, petioles and upper side of leaves pubescent when young, some hairs persisting until maturity; underside of leaves densely pubescent, sparsely so along veins as leaf matures; inflorescence pubescent except for the inner surface of the petals and upper portion of the style; fruits pubescent. Branchlets peeling in scrolls after fruiting. Mature **leaves** sometimes alternate, 2.5-10.7 x 0.7-3 cm, usually narrow-lanceolate but sometimes elliptic or oblong, 2.1-7.4 as long as wide; apex acute or slightly acuminate; base usually acute or sometimes barely obtuse; petiole 1-7 x c. 1-2 mm. **Flowers** axillary, solitary or rarely 2; bracts rare; bracteoles usually persisting until fruit maturation, narrow-ovate or elliptic, 3-10 mm; pedicels 0-8 x 1-3 mm; mature buds 8-12 x 8-9, pear-shaped. Calyx lobes equal, 2-4 mm, triangular, acuminate;

hypanthium cup prolonged above the staminal disk 1.5-2.5 mm., sometimes spliting between the calyx lobes. Petals 5-10 mm, not ciliate. Staminal disk 2-2.5 mm, circular, sloped towards the flat stylar base; stamens c. 330-490, 3-8 mm. Style c. 6 mm; ovary 2-2.5 mm with 8-10 loculi; ovules ± 60-90, 6-12 per loculus. **Berry** c. 1.5 cm, roundish.

Examined material - **Brazil. Distrito Federal:** Brasília, Campus da UnB, 20 Nov 1968, *Belém & Barroso* 3970 (UB); Fazenda Agua Limpa, 22 Jan 1980, *Cesar* 83/80 (UB); ibid., 5 Feb 1980, *Cesar* 142/80 (UB); ibid., 21 Nov 1979, *Cesar* 225 (E); Horto do Guará, 4 1961, *Heringer* 7811 (UB); Rio Bartolomeu, 2 Sep 1961, *Heringer* 8674 (UB); Sobradinho, 29 Aug 1975, *Heringer* 14944 (IBGE, UB); Reserva Ecológica do IBGE, 18 Dez 1986, *Silva & Alvarenga* 229 (IBGE); ibid., 18 Dez 1986, *Silva & Alvarenga* 282 (IBGE).

Distribution - *Campomanesia sessiliflora* var. *lanuginosa* grows in Bahia, Goiás and Mato Grosso do Sul and, as far as I know, is always a shrub. It is an uncommon species in the Distrito Federal and collectors have described its habitat as dry savanna woodland or open savanna woodland with sparse trees and shrubs.

Campomanesia sessiliflora var. *sessiliflora* is a tree that grows in the southeastern Brazilian coastal forests, while var. *bullata* is a shrub and grows inland but further south in Paraná, Mato Grosso do Sul and Paraguay.

6. *Campomanesia velutina* (Camb.) Berg, *Linnaea* 27:429. 1856. **(Fig. 3.32 & Fig. 4.2 h)**

Syn.: *Psidium velutina* Camb. in St. Hilaire, *Fl. Bras. Merid.* 2:288. 1833. Type. Brazil. 'Prope pagum vulgò Aldea de Boa Vista in parte occidentali-meridionali provinciae Minas Geraës' St. *Hilaire* s. n. (Holotype P n. v.)

Campomanesia riedeliana Berg in Martius, *Fl. Bras.* 14(1):610. 1859. Type. Brazil. 'Inter frutices prope Curvellos prov. Minarum' *Riedel* s. n. (Holotype LE n. v.)

C. rabeniana Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:11. 1893. Type. Brazil. 'Ad Lagoa Santa in virgultis silvestribus' *Warming* s. n. (Holotype C n. v.)

Trees to 6 m, predominantly pubescent. **Hairs** simple, mostly colurless to very pale brown, sometimes rufous on bracts. Branchlets, petioles and leaves pubescent when young, some hairs persisting until maturity on the branchlets, petioles and leaf veins; inflorescence pubescent except glabrous petals and style, the hairs denser and somewhat longer on the hypanthium, staminal disk, bracts and bracteoles; young fruits pubescent. Branchlets sometimes peeling inconspicuously in irregular flakes, oblong strips or short strings. Mature **leaves** 3.5-10.9 x 1.4.7 cm, elliptic or narrowly elliptic, 2.3-4.2 as long as wide; apex with an abrupt or tapering fine-tipped, mucronate acumen; base usually acute but sometimes cuneate, obtuse or rounded; petiole 2-11 x ca. 0.5 mm; blade not translucid dotted against the light. Precocious raceme 2-11.6 cm at anthesis (including young vegetative shoot), with (1)2-4(-6) **flowers**; bracts usually deciduous at fruit initiation, occasionally persisting longer, triangular, obtrullate or navicular, 1.5-8 x 1-3 mm; pedicels 0.5-3.3 x c. 0.1 cm; mature buds 6-6.5 x 4-5 mm, obovate. Calyx lobes usually equal, (2-)3-5 mm, triangular to narrow-triangular; hypanthium not prolonged above style base level. Petals c. 4 mm, ciliate. Disk c. 5 x 5 mm, flat, pentagonal. Stamens ± 70-110, 2-5 mm. Ovary 2-3 mm with 4-5 loculi; ovules c. 10-30, 4-9 per loculus; style 6-7 mm. **Berry** yellow-green, c. 1.5 cm, roundish; seeds orange, verrucose, reniform but flattish.

Examined material - **Brazil. Distrito Federal:** Jardim Botânico de Brasília, 20 Aug 1986, *Equipe do JBB* 709 (HEPH); ibid., 27 Oct 1988, *Proença* 698 (HEPH); Catetinho, 28 May 1964, *Heringer* 9853 (UB); RECOR, 17 Oct 1977, *Heringer et al.* 221 (IBGE); Bacia do Rio São Bartolomeu, 26 Oct 1979, *Heringer et al.* 2059; ibid., 5 Nov 1979, *Heringer et al.* 2701 (IBGE); ibid., 8 Nov 1979, *Heringer et al.* 2707 (IBGE); ibid., 13 Aug 1980, *Heringer et al.* 5307 (IBGE); ibid., 24 Sep 1980, *Heringer et al.* 5494 (IBGE); ibid., 21 Jul 1981, *Heringer et al.* 7172 (IBGE); Planaltina, 28 Sep 1965, *Irwin, et al.* 8758 (UB); Fazenda Agua Limpa, 19 Sep 1989, *Violatti et al.* 11 (IBGE); FERCAL, 35 km ao Norte de Brasília, 2 Oct 1967, *Lima* 4 (UB); Area de Preservação Ambiental do São Bartolomeu, 10 Sep 1987, *Mendonça & Paula* 861 (IBGE); Reserva Ecológica do IBGE, 20 Sep 1983, *Pereira* 782 (IBGE); FERCAL, 30 km ao Leste de Brasília, 19 Sep 1964, *Prance & Silva* 59062 (UB).

Vernacular name - Murtão (Distrito Federal).

Distribution - It grows in the Distrito Federal and States of Maranhão, Goiás and Minas Gerais. Collectors cites the habitat of this species as gallery forests, gallery forest fringes or savanna woodlands on calcareous soil.

3. *Pimenta* Lindley, *Coll. Bot.* 4, pl. 19. 1821. Type. *P. officinalis* Lindley.

Syn.: *Evanesca* Rafinesque, *Sylva tellur.* 105. 1838. Type. *E. crassifolia* Rafinesque.

Pimentus Rafinesque, *Sylva tellur.* 105. 1838. Type. *P. vera* Rafinesque.

Amomis Berg, *Handb. Pharm. Bot.* ed. 3, 1:339. 1855. Lectoype. *A. oblongata* Berg, *Fl. Neotropica* 45:78. 1986.

Pseudocaryophyllus Berg, *Linnaea* 27: 348 (in clave), 426. 1856. Lectoype.*Pseudocaryophyllus sericeus* Berg, *Taxon* 5(6):144. 1956.

Pimenta sect. *Amomis* (Berg) Niedenzu in Engl. & Prantl, *Nat. Pflanzenfam.* 3(7):71. 1893.

Pimenta sect. *Eupimenta* (Berg) Niedenzu in Engl. & Prantl, *Nat. Pflanzenfam.* 3(7):72. 1893. Nom. illeg. for sect. *Pimenta.*

Cryptorhiza Urban, *Repert. Spec. Nov. Regni Veg.* 27:403. 1921. Type. *C. haitiensis* Urban.

Krokia Urban, *Symb. Ant.* 9:468. 1928. Type. *K. nipensis* Urban.

Myrtekmania Urban, *Symb. Ant.* 9:484. 1928. Type. *M. adenoclada* (Urban) Urban.

Pimenta sect. *Orthopimenta* Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:513. 1941. Lectotype: *P. officinalis* Lindley, *Fl. Neotropica* 45:78. 1986.

Pimenta subsect. *Krokia* Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:512. 1941.

Pimenta subsect. *Myrtekmania* Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:513. 1941.

Mentodendron Lundell, *Wrightia* 4:180. 1971. Type. *Mentodendrom guatemalensis* Lundell.

Krokia sect. *Moamyrta* Borhidi in Borhidi & Muñiz, *Bot. Közlem* 64: 212. 1978. Type. *Amomis odiolens* Urban.

Krokia sect. *Myrtekmania* (Urban) Borhidi & Muñiz, *Bot. Közlem* 64: 212. 1978.

Trees or large shrubs. Leaves not glandular dotted against the light. Inflorescence a regularly dichotomous cyme (Distrito Federal), panicle or dichasium with sessile flowers in the forks. Bracts and bracteoles mostly

caducous before anthesis. Buds usually open at the apex with anthesis ocurring by opening of the calyx lobes (Distrito Federal), rarely closed with anthesis occurring by tearing into irregular lobes. Hypanthium usually slightly prolonged above style base level. Calyx lobes usually 4 (Distrito Federal), sometimes 5, equal. Petals 4 (Distrito Federal), sometimes 5, white. Anthers widely-elliptic; loculi opening by straight, longitudinal slits which are parallel to the filaments. Ovary 1-2(-3) locular; ovules 1-9 per loculus; stigma puntiform (Distrito Federal) or peltate. Berry usually with persistent calyx lobes (Distrito Federal). Seeds usually 1-2; testa usually membranaceous or cartaceous, rarely bony (Brazil). Embryo with a large, coiled hypocotyl and free, minute cotyledons.

A neotropical genus of 15 species, one in South America and the rest in Central America and in the West Indies (Landrum 1986) to which commercial allspice (*Pimenta dioica* L.) belongs.

1. ***Pimenta pseudocaryophyllus*** var. ***fulvescens*** (DC.) Landrum *Fl. Neotropica* 45:104. 1986. **(Fig. 3.33 & Fig. 4. 5)**

Syn.: *Eugenia fulvescens* A. P. de Candolle, *Prodr.* 3:283. 1828. Type. Brazil. Minas Gerais: 'Campis' [*Ackerman* 228] (Holotype BR n. v.)

E. mutabilis Berg in Martius, *Fl. Bras.* 14(1):311. 1857. Type. Brazil. Minas Gerais: 'Ad Congonhas do Campo' *Claussen* 523 (Lectotype, Isotype at BR n. v., *Fl. Neotropica* 45:104. 1986.); *Stephan* s. n. (Paratype BR n. v.)

Pseudocaryophyllus fulvescens (DC.) Berg, *Linnaea* 27:416. 1856.

P. velutinus Berg in Martius, *Fl. Bras.* 14(1):607. 1859. Type. Brazil. Minas Gerais: 'In regiones Sertâo dictae campis inter Curvellos et Jaguará nec non in collibus silvaticis prope Jaguará' *Riedel* s. n. (Holotype LE n. v.)

Myrtus fulvescens (DC.) Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:24. 1893.

M. velutina (Berg) Kiaersk. in Warming, *Symb. Fl. Bras. Centr.* 39:25. 1893.

M. velutina forma *macrophylla* Kiearsk. in Warming, *Symb. Fl. Bras. Centr.* 39:25. 1893. Type. Brazil. Minas Gerais: 'Lagoa Santa' *Warming* s. n. (Holotype C n. v.)

Pseudocaryophyllus mutabilis (Berg) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:518. 1941.

P. platyphyllus Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 15:517. 1941. Type. Brazil. Bahia: 'Caeteté in Zentral-Bahia' *Zehntner* 4047 (Holotype B -

destroyed).

Trees to 5 m. **Hairs** simple, cream, yellowish or yellow ochre, very fine and curly; young vegetative parts densely pubescent; mature branchlets, petioles and lower surface of the leaves sparsely pubescent, the upper surface of the leaves glabrous except along the principal veins; axis of the inflorescence, bracts and flowers densely pubescent; only inner surface of the petals and upper portion of the style glabrous. Leaves (3.5-)9-20.3 x (1.7-)3.6-8.2 cm., 1.8-3.1 times as long as wide, elliptic to widely elliptic; base acute, acuminate or barely obtuse; petiole 8-18 x ca. 1.5-2.5 mm. Cyme 5-10 cm. with 9-45 **flowers** if no buds are aborted; peduncle 2.5-6.5 x 1.5-1.75 mm; pedicels 0 or 2.5-9 mm; mature buds c. 6 x 4.5-6 mm, obovate. Calyx lobes equal, c. 2 mm, obverse-elliptic, rounded or truncate frequently tearing at base during anthesis; hypanthium not prolonged above style base level. Petals obovate to transverse-elliptic, 3-4 mm. Staminal disk c. 3.5 x 3.5 mm, square, flat. Stamens ± 150-190, 4.5-9.5 mm; anthers 0.25-0.5 mm. Ovary c. 2 mm with 2 loculi; ovules 8-10, 4-6 per loculus; style 6-7 mm. Mature **berry** black, 10-12 mm; fruiting sepals curved inwards; seeds 1(-3), cream.

Examined material - **Brazil. Distrito Federal:** Jardim Botânico de Brasília, 13 Jun 1985, *Equipe do JBB (Jardim Botânico de Brasília)* 444 (HEPH); ibid., 6 Aug 1985, *Equipe do JBB* 517 (HEPH, IBGE); ibid., 30 Oct 1985, *Equipe do JBB* 599 (HEPH); ibid., 2 Dez 1986, *Equipe do JBB* 791 (HEPH, IBGE); Brasília, E of the lake on the road to the prison, 2 Oct 1972, *Ratter et al.* 2674 (E); **Minas Gerais:** Patrocíneo, Chapada da Pratinha, 15 Nov 1985, *Felfili et al.* 38 (IBGE).

Vernacular names & uses - Limão-do-Mato, Casca-rosa (Minas Gerais); Louro, Louro-cravo, Cravo-da-terra, Cha-de-bugre (Santa Catarina, Legrand & Klein 1978). The tea of the leaves is supposed to be calming (Legrand & Klein 1978). The bark of 'Casca-Rosa' is sold by herb dealers in Rio de Janeiro as a remedy against hair loss but this could be another species.

Distribution - This variety also grows in Western Bolivia and in the Brazilian States of Bahia, Minas Gerais and Goiás. The other two varieties, var. *pseudocaryophyllus* and var. *hoehnei* grow in the humid coastal forests of the states of São Paulo, Paraná and Santa Catarina. P. *pseudocaryophyllus* var. *pseudocaryophyllus* also extends into the mountains of Rio de Janeiro and Minas Gerais just south of Bahia.

Fig. 4.3 - *Blepharocalyx salicifolius:* A) Habit; B) Bud; C) Flower after petals, stamens and style have fallen; D) Petal; E) Stamen; F) Fruit (*Azevedo & Lopes* 337).

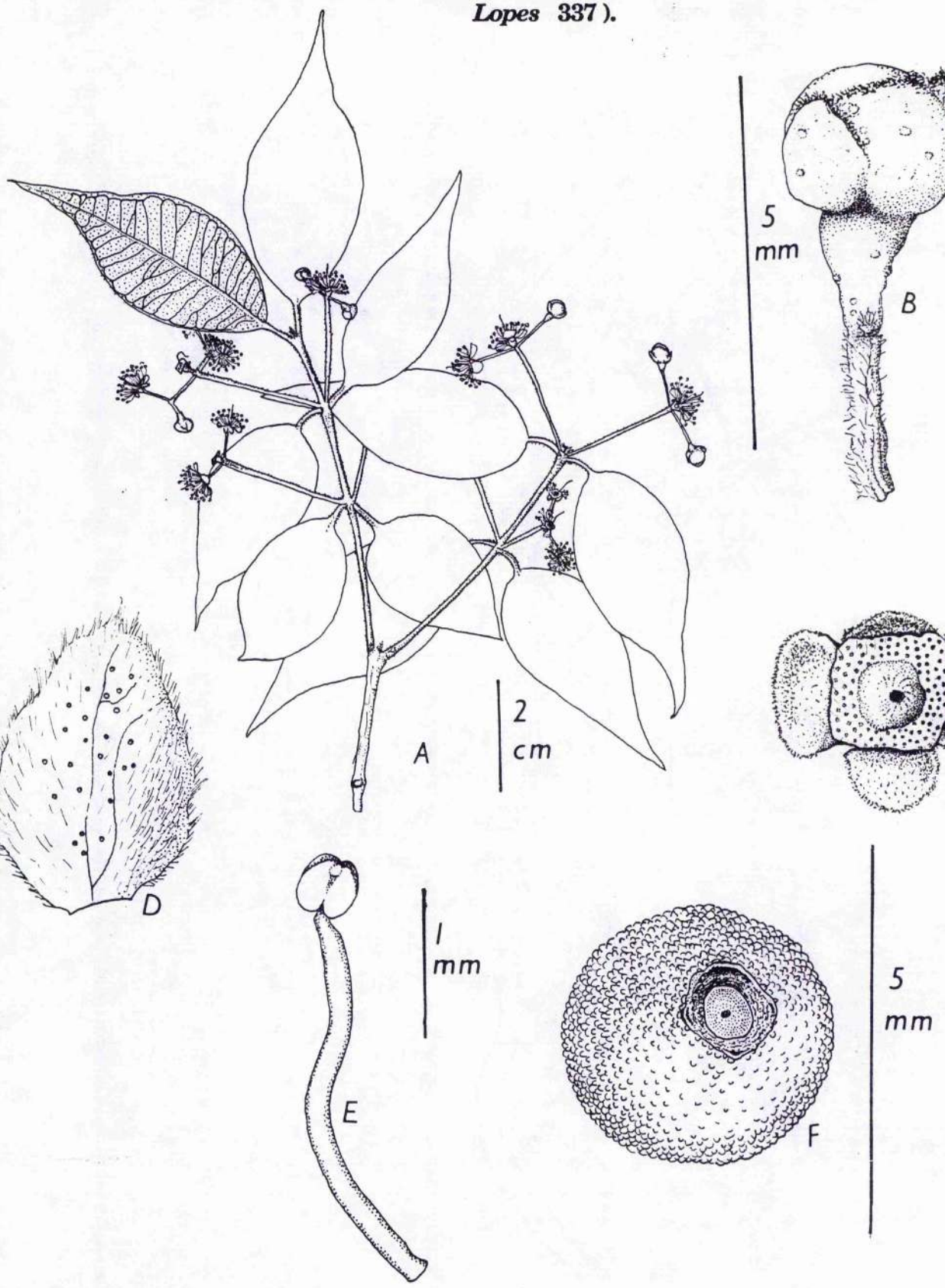


Fig. 4.4 - *Campomanesia adamantium:* A) Habit; B) Flower bud; C) Petal; D) Anther (*Irwin & Soderstrom* 5997).

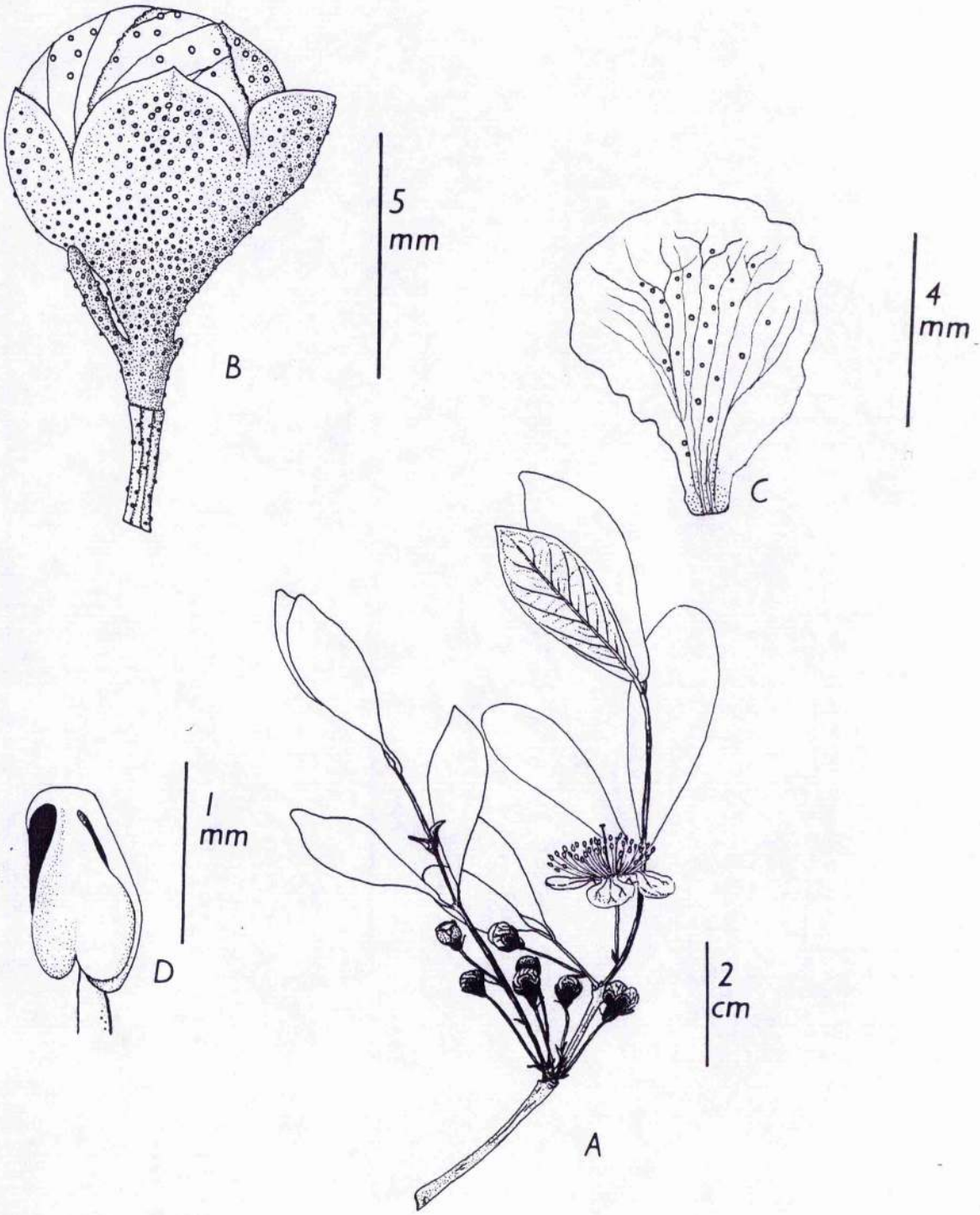
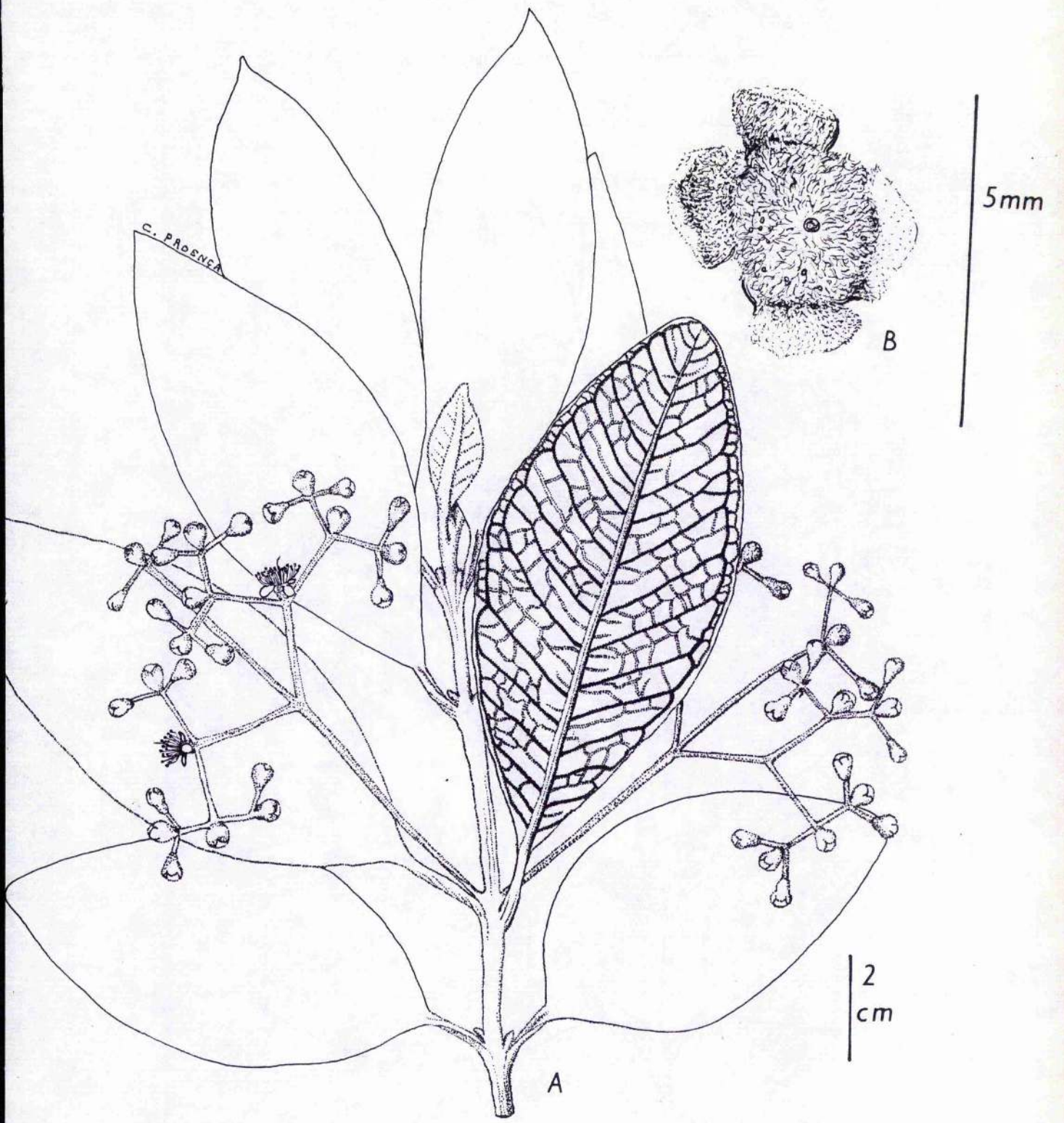


Fig. 4.5 - *Pimenta pseudocaryophyllys* var. *fulvescens:* A) Habit; B) Flower after petals, stamens and style have fallen (*Equipe do JBB* 599)



Psidium L. *Species Plantarum* : 470. 1753. *Genera Plantarum.* 1754. Type. *P. guajava* L.

Syn.: *Guiava* Adans., *Familia Plantarum* 2:88, 563. 1763. Type. *G. pyriformis* Adans. = *P. guajava* L.

Calyptropsidium Berg, *Linnaea* 27: 349. 1854. Type. *C. friedrichsthalianum Berg* = *Psidium friedrichsthalianum* (Berg) Nied.

Psidiopsis Berg, *Linnaea* 27:350. 1854. monotypic genus.

Mitropsidium Burret, *Notzbl. Bot. Gart. Berlin-Dahlem* 15:486. 1941. Type. *M. pittieri* Burret.

Trees, shrubs or perennial subshrubs woody at base or underground. Inflorescence a solitary flower, dichasium or highly modified raceme in which the rachis continues vegetative growth and produces leaves under each bud so that it seems like a branch with a series of solitary, axillary flowers in later stages (precocious raceme). Bracts and bracteoles free. Buds open or closed at the apex with anthesis ocurring by calyptra, opening of the calyx lobes or by irregular rupture of the hypanthium. Hypanthium slightly to much prolonged above the level of insertion of the style. Calyx lobes, when present 2-5. Petals (4-)5. Ovary 2-5-locular; ovules usually several to many per loculus; stigma usually somewhat expanded, not truncate. Berry crowned by the persistent dry or green calyx lobes or hypanthial remnants. Seeds usually several to many; testa bony, rather dull. Embryo with a large, curved or uncinate hypocotyl and free, minute cotyledons.

This is the largest genus in the Myrtiinae, with c. 100 species to which the widely cultvated guava (*Psidium guajava* L.) belongs. It is distributed throughout the Neotropics, from Mexico and the West Indies to Northern Argentina, and is represented in the Distrito Federal by 13 species.

Key to flowering material

1a Flower buds glabrous or nearly so, the calyx lobes and petals sometimes ciliate.....2
1b Flower buds conspicuously strigulose, pubescent or lanate.....7

2a Three-flowered dichasia often present; flower bud closed to the apex, apiculate or with 5 minute, tightly valvate teeth (the petal globe hidden), tearing deeply at anthesis.....3
2b Flowers solitary or in pauciflorous racemes; flower bud with 5 open calyx

lobes (the petal globe at least partially exposed), some slight tearing between lobes sometimes occurring at anthesis.....4

3a Flowers opening by a calyptra or irregular tearing into 2-5 lobes, these glabrous inside; young branches terete or slightly compressed; large trees in gallery forests.....13. *P. sartorianum*
3b Flowers opening by regular tearing into 5 lobes, these densely sericeous inside; young branches quadrangular; shrubs or small trees in savannas.....2. *P. australe*

4a Mature buds 7-13 mm long; petioles stout, 1-7 mm long; leaves opaque with rounded or subcordate, rarely obtuse bases.....6
4b Mature buds 4.5-6.5(-8) mm long; petioles absent to 2.5 mm long; leaves usually rather shiny with acute or obtuse, rarely abruptly subcordate bases..5

5a Flowers always solitary; staminal disk 4-5 mm wide with less than 160 stamens in 3-4 whorls; narrowest leaves above 2.6 as long as wide.....8. *P. luridum*
5b Flowers solitary or in racemes; staminal disk 4.5-6 mm wide with more than 170 stamens in 4-6 whorls; leaves between 1.5-2.6 times as long as wide; shrubs to trees.....10. *P. pohlianum*

6a Calyx lobes widely deltoid, 1-1.5 mm in bud, to 2 mm after anthesis, minutely sericeous inside; bracteoles usually caducous in young bud; trees in gallery forests.....5. *P. longipedicellatum*
6b Calyx lobes narrowly deltoid, 1-3.5 mm in bud, to 4 mm after anthesis, glabrous inside; bracteoles usually caducous at anthesis or later; shrubs in savannas.....5. *P. firmum*

7a Flowers nearly always solitary; petals glabrous; hypanthial indumentum dense.....8
7b Flowers solitary or in 3-flowered dichasia; petals puberulous, hidden in the bud or, if glabrous, hypanthial indumentum strigulose, very sparse on calyx lobes.....9

8a Bracteoles 1.5-3.5 mm long; calyx lobes obtuse or rounded; pedicels 3-18 mm long; small tree or shrub.....1. *P. aerugineum*
8b Bracteoles 4.5-7 mm long; calyx lobes acute; pedicels 10-35 mm long; hemixyle.....3. *P. bergianum*

9a Flower bud closed to the apex or nearly so (the petal globe completely hidden or a small apical portion only exposed), tearing deeply at anthesis.....10
9b Flower bud with 5 shallow calyx lobes (the petal globe well exposed), some slight tearing between lobes sometimes occurring at anthesis.....11

10a Young branches terete or compressed; young buds completely closed or with a sinuous pore at the apex; anthers oblong to linear-elliptic, 0.5-3 mm long.....6. *P. guineense*
10b Young branches quadrangular; young buds with 5 minute, valvate teeth which tear regularly as the bud matures; anthers roundish to oblong, 0.5-1 mm long.....12

11a Bracteoles caducous in young bud; small trees.....9. *P. myrsinoides*
11b Bracteoles caducous at anthesis; hemixyles.....11. *P. pubifolium*

12a Stamens c. 300-500; leaves 1-1.6 times as long as wide (round to obovate); mature leaves below pubescent to lanugineous, the indumentum very white to pale grey.....4. *P. cinereum*
12b Stamens c. 200-300; leaves 1.4-7.3 times as long as wide (obovate to narrow-lanceolate); mature leaves glabrous, puberulous or strigulose, the indumentum greenish-grey, yellowish-grey or colourless.....2. *P. australe*

Key to sterile and fruiting material

1a Trees.....2
1b Large to small shrubs, usually in cerrado *sensu lato* 10

2a Large trees in gallery forests, potentially to 20 m; leaves 1-7.5 times as long as wide; seeds 6-8 mm long, c. 2-10 per fruit.....3
2b Small trees in cerrado *sensu lato,* usually between 2-5(-8) m; leaves 1-3.5 as long as wide; seeds 2-4.5(-7), varying greatly in number.....4

3a Petioles 4-15 mm; leaves widest above the middle, to 15 cm long, only the smallest occasionally below 5 cm long; fruit glabrous.....7. *P. longipetiolatum*
3b Petioles 1-4.5 mm; leaves widest at the middle, always below 5 cm long; fruit pubescent when young, retaining a collar of pubescence beneath the calyx lobes.....12a. *P. rufum* var. *widgrenianum*

4a Young branches quadrangular, usually glabrous or with short, strigulose hairs and conspicuous elevated subepidermal glands.....2. *P. australe*
4b Young branches terete or slightly compressed, usually pubescent, if glabrous eglandular or subepidermal glands obscure.....5

5a Mature leaves completely glabrous; petioles less that 4 mm; leaves 1-5 cm wide.....6
5b Mature leaves pubescent on underside or at least retaining sparse hairs; petioles 0-10 mm; leaves 2-7 cm wide.....7

6a Bark of the trunk and old branches dehiscent in thick, broken rings; leaves not glandular-dotted against the light; fruiting calyx lobes pubescent inside; seeds 2-4 mm long, usually more than 10.....9. *P. myrsinoides*
6b Bark of the trunk and old branches dehiscent in rectangular plates; leaves glandular-dotted against the light; seeds 6-7 mm, usually less than 10.....10. *P. pohlianum*

7a Petioles 2.5-10 mm long; leaves with lateral veins arching away from the leaf margin when joining the next pair, not forming a clear submarginal vein; fruiting hypanthial lobes 2-8 mm, oblong, acute, erect or diverging; seeds c. 3 mm.....6. *P. guineense*
7b Petioles 0.25-2.5 mm long; leaves with lateral veins running straight until close to the leaf margin, forming a clear submarginal vein; fruiting calyx lobes 1-4 mm long, rounded or obtuse, explanate; seeds 3.5-4.5 mm long.....7. *P. aerugineum*

8a Young branches quadrangular or alate.....9
8b Young branches terete or compressed.....10

9a Leaves 1.4-7.3 times as long as wide (obovate to narrow-lanceolate); mature

leaves glabrous, puberulous or strigose, the indumentum greenish-grey, yellowish-grey or colourless; fruits glabrous.....2. *P. australe*

9b Leaves 1-1.6 times as long as wide (round to obovate); mature leaves below pubescent to lanugineous, the indumentum very white to pale grey; fruits pubescent when young, this sometimes persisting in patches to maturity.....4. *P. cinereum*

10a New growth rarely with sparse, very short hairs; mature leaves glabrous.....11

10b New growth densely pubescent to villous; mature leaves densely to sparsely pubescent below.....13

11a Petioles rather stout 1-7mm long; smallest leaves c. 3 cm; fruit yellow-green when mature, with firm flesh; seeds 2-3 mm.....5. *P. firmum*

11b Petioles barely present to c. 2 mm; smallest leaves c. 1.5 cm; fruit yellow when mature, with soft flesh; seeds 3-7 mm.....12

12a Narrowest leaves 2.7-3.7 times as long as wide; leaf base cuneate to barely obtuse; seeds 3-4 mm.....8. *P. luridum*

12b Leaves 1.5-2.6 times as long as wide; leaf base acute to obtuse, at least some of the leaves minutely subcordate at extreme base; seeds 4-7 mm.....10. *P. pohlianum*

15a Leaves with lateral veins arching away from the leaf margin when joining the next pair, not forming a clear submarginal vein.....6. *P. guineense*

15b Leaves with lateral veins running straight until close to the leaf margin, forming a clear submarginal vein.....14

14a Shrubs (or trees in the absence of fire) in cerrado sensu lato, if shrubby usually with a short, dark-grey, corky-barked stump; leaves densely pubescent when young, retaining a rather dense pubescence below even at maturity.....1. *P. aerugineum*

14b Hemixyles 0.15 to 0.6 m in rather open grassy cerrados; mature leaves usually with sparse hairs below at maturity, sometimes sparsely pubescent or glabrous.....15

15a Leaves with 10-20 pairs of lateral veins; leaf apex acute to thickly acuminate, but the acumen sometimes as above; fruiting pedicels solitary, concentrated at basal nodes.....3. P. *bergianum*

15b Leaves with 6-8(-10) pairs of lateral veins; leaf apex frequently ending in a very short, mucronate acumen; fruiting pedicels solitary or in dichasia, evenly spaced.....11. *P. pubifolium*

1. ***Psidium aerugineum*** Berg, Fl. Bras. 14(1): 391. 1857. Type. Brazil. Rio Grande do Sul: *Sellow* s. n. (Holotype B - destroyed) (**Fig. 3.34**)

Syn.: ? *Psidium warmingianum* var. *verticillata* Kiaersk., *Symb. Fl. Bras. Centr.* 39: 28. 1893. **nov. syn.** Syntypes. Brazil. São Paulo: 'Ad Hytu, m. Jan. 1836' *Raben* s. n.; Minas Gerais: 'Ad Lagoa Santa cum forma typica' *Lund & Warming* s. n. (Holotype C? n. v.)

Small **tree** to subshrub 0.3-4 m, predominantly pubescent. **Hairs** very fine, wiry, yellowish- or greenish-grey to pale golden brown; ovary, pedicels and vegetative buds velutinous; undersurface of the leaves, petioles, sepals and staminal disk densely pubescent; upper surface of leaves pubescent to nearly glabrous, some hairs usually persisting along the midvein; fruit glabrous at maturity but retaining a collar of pubescence beneath the calyx lobes; petals, androecium and gynoecium glabrous. Bark of trunk dark grey, deeply fissured in a grid-like pattern, corky. Mature **leaves** 3.3-12 x 2-7 cm, 1.5-2.5 times as long as wide, obovate or rarely wide-elliptic; apex rounded, obtuse or rarely acuminate, the acumen short, thick, rounded or blunt at extreme tip; base acute to cuneate, sometimes abruptly rounded or subcordate at extreme base; petiole absent to 2.5 x 1.25-2.5 mm. **Flowers** solitary or in 2-4 flowered precocious or normal racemes; racemes to 4 cm, axillary or lateral; peduncle absent to 3 mm; bracteoles usually deciduous before to just after anthesis, 1.5-3.5 mm, linear-lanceolate; pedicels 3-18 x 0.5-1 mm; mature buds 5.5-8.5 x 3-8 mm, obovate to pear-shaped; anthesis occurring by the 5 lobes opening, sometimes with slight tearing at some of the sinuses. Calyx lobes 0.5-3.5 x 0.5-2 mm in bud, after anthesis 1-4 mm, equal to subequal, deltoid, obtuse, ciliate; hypanthium very slightly prolonged above stylar insertion. Petals 3.5-7.5 mm, suborbicular, ciliate. Staminal disk 3.5-6 mm across, flat, pentagonal, stamens 152-168 in 4-6 irregular whorls, 4-5.5 mm; anthers c. 0.5 mm, roundish, the apical gland imperceptible. Style 4.5-7.5 mm; ovary 2-3 mm; locules 3; ovules c. 28-46, c. 8-17 per loculus; stigma discoid. **Berry** yellow-green, 15-20 mm, roundish, somewhat oblate or slightly obovate, crowned by the explanate calyx lobes; seeds light brown, c. 4-7, 3.5-4.5 mm, roundish to elliptic; embryo pimentoide.

Examined material - **Brazil: Distrito Federal:** Cemitério do Plano Piloto, 10 Dec 1965, *Belém* 1949 (UB); Fazenda Agua Limpa, 7 May 1984, *Haridasan* 493 (UB); Catetinho, 5 Nov 1973, *Heringer* 12954 (UB, UEC); Horto do Guará, 20 Oct 1961, *Heringer* 8744 (UB); Rio Corumbá, 8 Sep 1964, *Heringer & Belém* 9790 (UB); Brasília, 950 m, 2 Feb 1966, *Irwin & Grear* 12200 (UB); C. 10 km NW of Planaltina, 950 m, 27 Feb 1966, *Irwin & Grear Jr.* 13884 (UB); Chapada da Contagem, 1000 m, 5 Sep 1965, *Irwin* 8005 (UB); Chapada da Contagem, 1000 m, 13 Sep 1965, *Irwin* 8268 (UB); Fazenda Agua Limpa, 1100 m, 11 Feb 1981, *Kirkbride* 1436 (UB); (Reserva Ecológica do) Jardim Botânico de Brasília, Feb 1989, *Proença* s. n. (HEPH); Fazenda Agua Limpa, 26 Oct 1976, *Ratter* 3883 (E);

Fazenda Agua Limpa, 10 Aug 1982, *Ratter* 4714v (E, UB); **Minas Gerais:** Patrocíneo, 15 Nov 1988, *Felfili & Alvarenga* 34 (IBGE); Pimenta, 9 Nov 1982, *Silva et al.* 3322 (UEC); **Goiás:** Leopoldo de Bulhões, 12 Jan 1989, *Filgueiras & Pereira* 1748 (IBGE); Cidade Eclética, 10 Sep 1973, *Heringer* 12962 (UEC); **São Paulo:** Santa Rita do Passa Quatro, 700 m, Oct 1985, *Castro* 19719 (UEC); **Mato Grosso:** Salgadeira, Chapada dos Guimarães, 26 Jun 1983, *Oliveira Filho* 119 (UEC); ibid., 14 Sep 1983, *Oliveira Filho* 143 (UEC); Chapada dos Guimarães, 30 Dec 1978, *Macedo & Duarte* 1005 (UEC); Est. Paranatinga, 7 Oct 1980, *Macedo & Assumpção* 1744 (UEC).

Vernacular names - Araçá do Campo (Distrito Federal).

Distribution - Probably through the western part of the Southern Brazilian states from Rio Grande do Sul to Minas Gerais, and also in the Distrito Federal, Goiás, Mato Grosso do Sul and Mato Grosso (Map).

Discussion - When shrubby, this species is very hard to separate from *P. bergianum,* which led Kiaerskov to create a new variety (var. *verticillata*) of that species under the synonym *Psidium warmingianum.* I have not seen the type but the diagnostic characters given by Kiaerskov are exactly those that separate the two species, which occur together.

Like so many other Berg names in *Flora Brasiliensis, P. aerugineum* was based upon a Sellow s. n. collection from Rio Grande do Sul at Berlin, for which I have not been successful in locating duplicates, so that the application of this name must remain somewhat tentative. It was, however, adopted by Legrand for this species. Legrand (1936, 1938) thanks Burret, a specialist in Myrtaceae at Berlin, for courteously answering his 'insistent consultations', presumably regarding comparison with Berlin types, so perhaps Burret compared material of this species to the then extant type.

2. ***Psidium australe*** Camb., *Flora Brasiliensis Meridionalis* 2: 283. 1833. Type. Brazil. Rio Grande do Sul: 'Prope vicum vulgò Capella de Sta. Maria ad fines provinciarum Rio Grande de S. Pedro do Sul et Missionum' *Saint Hilaire* s. n. (Holotype P? n. v.) (**Fig. 3.35**)

Syn.: *Psidium suffruticosum* Berg, *Fl. Bras.* 14(1): 387. 1857. **nov. syn.** Type.

Brazil. Goiás?: 'in pascuis desertorum (fide Berg, 1857)' *Pohl* 1021 (Holotype W n. v., Isotype K!).

Psidium suffruticosum var. *alata* Kiaersk., *Symb. Fl. Bras. Centr.* 39: 27. 1893. **nov. syn.** Type. Brazil. Minas Gerais: 'Serra de S. José del Rey (fide Glaziou 1908)' *Glaziou* 16972 (Holotype C n. v., Isotype K!).

Psidium mucronatum Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier (Ser. 2)* 1: 798. 1903. **nov. syn.** Type. Paraguay: 'In altoplanitie et decliviis Sierra de Maracayú', Oct 1899, *Hassler* 5082. (Holotype RB? n. v., Isotype K!).

Psidium emilhasslerianum Barb. Rodr. ex Chod. & Hassler, *Bull. Herb. Boissier (Ser. 2)* 1: 799. 1903. **nov. syn.** Type. Paraguay: 'In campis prope Tacuaral', Oct 1885-95, *Hassler* 1330 (Holotype RB? n. v., Isotype K!)

Small **tree** to subshrub, 0.3-2 m, glabrous or frequently appearing so. **Hairs** minute or very short, strigulose, pale whitish-grey or yellowish-grey; leaves densely to very sparsely puberulent with minute hairs below; buds sometimes with short stiff hairs on the ovary which thin out on the calyx lobes; inner surface of the calyx lobes densely sericeous at least at tips; upper surface of the leaves and sometimes staminal disk with sparse hairs. Bark of thicker branches tan, smooth; young twigs quadrangular to subalate, glandular; mature **leaves** very variable in shape and size, 1.6-9 x 0.5-4.8 cm, 1.4-7.3 times as long as wide, obovate, oblanceolate or lanceolate; apex short-acuminate, acute, obtuse or rounded but at least some of the leaves usually ending in an abrupt, 1-3 mm fine-tipped acumen; base cuneate to barely obtuse; petiole 0-5 x 0-2 mm. **Flowers** solitary or in 3-flowered dichasia, axillary; peduncle 10-17 cm; bracts and bracteoles mostly deciduous in bud to just after anthesis, 2-6 mm, linear to elliptic; pedicels 3.5-16 x 0.5-1 mm; mature buds pear-shaped, almost closed, with 5 minute teeth at apex, 6-10.5 x 4.5-8 mm; anthesis occurs as the 5 lobes open and tear the hypanthial cup. Calyx lobes equal to unequal, 0.5-1 mm in bud, 1-4 mm after anthesis, truncate then abruptly apiculate, ciliate at tip; hypanthium prolonged 1-3.5 mm above stylar insertion. Petals 6.5-8 mm, eciliate. Staminal disk 5.5-8 mm across, flat, pentagonal, stamens 200-318 in 5-7 irregular whorls, 3-7.5 mm; anthers 0.5-1 mm, oblong, with an apical gland. Style 4.5-10 mm; ovary 2-3 mm, locules 3-4; ovules c. 100-212, c. 28-68 per loculus; stigma capitate. **Berry** c. 13 mm long, pear shaped to slightly obovate, crowned by the somewhat flaring calyx lobes; seeds c. 6, 2 mm, roundish to oblong; testa cream; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Brasília, 10 Dec 1968, *Belém & Barroso* 4026 (UB); Fazenda Agua Limpa, 22 Nov 1979, *Cesar* 232 (HEPH); ibid., 4 Mar 1980, *Cesar* 361 (UB); ibid. , 22 Jan 1980, *Cesar* 37 (HEPH); 500 m da margem do Lago Paranoá, 9 Nov 1978, *Heringer & Paula* 699 (IBGE); **Minas Gerais:** Patrocíneo, 15 Nov 1988, *Felfili & Alvarenga* 35 (IBGE); S. José del Rey, *Glaziou* 16972 (K); C. 10 km NW of Paracatú, 900 m, 3 Feb 1970, *Irwin & Onishi* 25885 (UEC); Lavras, 7 Dec 1983, *Leitão Filho & Semir* 15305 (UEC); **Goiás:** C. 60 km S of Caiapônia on road to Jataí, 900 m, 27 Oct 1964, *Irwin & Soderstrom* 7432 (UEC); *Pohl* 1021 (K); *Pohl* s. n. (F); **São Paulo:** Estrada que liga Vitoriana a Rio Bonito, 24 Oct 1985, *Amaral Jr. & Campos* 81 (UEC); Botucatú, 30 Nov 1986, *Bicudo & Campos* 1691 (UEC); Mogi-Guaçú, 10 Oct 1977, *Leitão Filho & Yamamoto* 6049 (UEC); ibid., 21 Oct 1977, *Leitão Filho & Semir* 9135 (UEC); **Paraná:** Almirante Tamandaré, 19 Nov 1963, *Hatschbach & Pereira* 10661 (K). **Paraguay:** Prope Tacuaral, Oct 1885-95, *Hassler* 1330 (K); Sierra de Maracayú, Oct 1899, *Hassler* 5082 (K).

Vernacular names - Araçá (Santa Catarina, Legrand 1977; Distrito Federal, São Paulo).

Distribution - A wide-spread species occurring in Argentina, Paraguay, Southern and Central Brazil. This species occurs in campo sujo to cerradão.

Discussion - This circumscription of this species has been expanded to include a narrow-leaved, glabrous form described as *Psidium suffruticosum* by Berg (1857) from Goiás. A recent collection, *Felfili & Alvarenga* 35, from the 'triângulo mineiro' in western Minas Gerais is morphologically intermediate between classical *P. australe* (senso Legrand 1977, Rotman 1976) and *P. suffruticosum.*

The descriptions of three other Berg species also seem similar to *P. australe* but I have not examined the types and so am hesitant to propose formal mergers in a species that is so close to *P. cinereum.* These taxa are *P. radicans* (Berg, 1857), *P. riedelianum* & *P. alatum* Berg (1859). *P. radicans* was based on a sterile Sellow collection from Rio Grande do Sul at Berlin; the leaves fit *P. australe* but the common name, Uvalha-do-campo, is usually used for species of *Eugenia* so perhaps this is not a *Psidium* at all. The latter two species were described in the *Supplementum* to *Flora Brasiliensis* and were based on material collected by Riedel in dry fields of central Minas Gerais now in the

Leningrad herbarium.

P. mucronatum and *P. emilhasslerianum* from Paraguay are fairly typical of the more southerly collections of this species. The former is of questionable legality as it was not accepted by the authors: Chodat and Hassler (1903) published this Barbosa Rodrigues name but added a note in parenthesis that 'An *P. incanescenti* Mart. var.' The Cesar collections ns. 37 and 361, from the same campo sujo, have bullate leaves which make them quite strikingly different from usual *P. australe*. I was unable to find any other distinguishing characteristics however, and thus tentatively retain them in this species until further collections are available.

3. ***Psidium bergianum*** (Nied.) Burret, *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 485. 1941. Based on *Myrtus bergiana*. **(Fig. 3.36)**

Syn.: *Campomanesia suffruticosa* Berg, *Fl. Bras.* 14(1): 448. 1857. Type. Brazil. Ceará: Serra do Araripe, Oct 1838, *Gardner* 1611 (Lectotype W, Isolectotype, BR n. v., F!, K!).

Myrtus bergiana Nied., *Nat. Pflanzenfam.* 3(7): 66. 1893. Based on *Campomanesia suffruticosa.*

Psidium warmingianum Kiaersk., *Symb. Fl. Bras. Centr.* 39: 28. 1893. Based on *Campomanesia suffruticosa.*

? *M. hassleriana* Barb. Rodr., *Myrtacées du Paraguay* 16, Tab. 20. 1903. **nov. syn.** Type. Paraguay: 'in campo ad regione prope Rio Curuguatay' *Hassler* 4609 (Holotype RB? G? n. v.).

Subshrubby hemixyle 0.15-0.6 m, villous when young, imperceptibly pubescent at maturity. Hairs simple, straw-coloured to yellowish-grey; the young vegetative parts, ovary, young fruit and the calyx lobes within villous, the underside of the leaves and fruit retaining some pubescence at maturity; pedicels, bracteoles, calyx lobes without and sometimes staminal disk and style base pubescent; petals and androecium glabrous. Mature **leaves** 2.6-10 x 0.9-5 cm, 1.5-3.6 times as long as wide, obovate or elliptic; apex acute or slightly acuminate, the acumen 1-4 mm, rather fine-tipped; base acute; petiole 1-4 x 1-2 mm. **Flowers** solitary, axillary or at basal, leafless nodes; bracteoles deciduous between anthesis and fruit initiation, 4.5-7 mm, linear-lanceolate; pedicels 10-35

x 0.5-1 mm; mature buds 7-10 x 4.5-8 mm, pear-shaped; anthesis occurs as the 5 lobes open, sometimes with slight tearing at some of the sinuses. Calyx lobes equal to subequal, 1.5-4 mm, triangular, acute, densely ciliate; hypanthium very slightly prolonged above stylar insertion. Petals white, 4-8 mm, roundish or somewhat obovate, slightly ciliate to eciliate. Staminal disk 4-6 mm across, pentagonal or nearly circular, flat or on a slight slope, with tufts of hairs at the angles; stamens c. 163-201 in c. 4 irregular whorls, 3.5-5.5 mm; anthers 0.5-0.75 mm, roundish to elliptic. Style 6.5-8 mm; ovary 3-4.5 mm; locules 2-3; ovules 36-68, 14-28 per loculus; stigma capitate. **Berry** yellow-green 16-18 mm long, roundish, crowned by the outcurved, somewhat flaring calyx lobes; epicarp thin, endocarp juicy, seeds c.10-19, straw-coloured, 3.5-4.5 mm, irregular, roundish or lenticulate.

Material examined - **Brazil. Distrito Federal:** Fazenda Agua Limpa, 11 Sep 1979, *Cesar* 699 (E); Estação Experimental da Universidade de Brasília, 26 Nov 1972, *Ferreira* 1568 (HEPH); Brasília, Plano Piloto, 20 Sep 1962, *Heringer* 9007 (HEPH); Reserva Ecológica do IBGE, 25 Nov 1986, *Proença* 654 (HEPH); ibid., 15 Dec 1986, *Proença* 671 (HEPH); FERCAL, 18 Jan 1987, *Ramos & Proença* s. n. (HEPH); Campus da Universidade de Brasília, 7 Nov 1974, *Taxonomy Class of the Universidade de Brasília* 552 (UB); **Minas Gerais:** Lagoa Santa, 5 Feb 1864, *Warming* s. n. (C); **Goiás:** 62 km de Alto Araguia na Rodovia BR-364 direção Cuiabá, Oct 1983, *Rodrigues* 10386 (UEC); **Ceará:** Serra do Araripe, Oct 1838, *Gardner* '1610' (F, K); ibid., *Gardner* 1611 (F, K).

Distribution - A very widespread species, *Psidium bergianum* grows throughout the cerrados region, from the Chapada do Araripe in Ceará to the campos of southern Brazil, Paraguay and Argentina. A hemixyle that flowers after burning, this species seems to occur mostly in rather open, grassy conditions such as sparse cerrado or campo sujo in the Distrito Federal, and most likely also in the rest of its area of distribution.

Discussion - *Psidium bergianum* is very close to *P. pubifolium.* In flowering material the former can be distinguished from that species by its lanate buds with bracteoles that much surpass the ovary and acute calyx lobes; the buds are produced alongside the new leaves, so that flowering specimens have yellow-lanate, immature leaves, such as occurs in *Campomanesia pubescens.*

P. bergianum is also very close to *P. aerugineum* and I am unable to distinguish sterile branches with mature leaves of the two species in the Herbarium. In the field *P. bergianum* is recognizable by being an apparently genetically fixed hemixyle, the branches always sprouting from the xylopodium below ground level; the rapid growth gives the shrub a characteristic appearence, with leaves diminishing rapidly in size towards the base. *P. aerugineum* usually has a recognizable stump with corky, grey bark and will grow into a tree in the absence of fire.

In the *Flora Brasiliensis,* Berg (1857) based *Campomanesia suffruticosa* on Gardner 1610 and 1611 and, a few pages later, another name, *Psidium gardnerianum,* was based on Gardner 1610. That these two species are completely different is obvious by the descriptions. I believe Gardner's 1610 and 1611 collections, both from the Serra do Araripe in Ceará, became mixed up while sorting in the Herbarium and that as a consequence collection 1611 (Berg's *C. suffruticosa*) was distributed under both numbers to B, F, K and W. As far as I know, there are no mixed collections on the same herbarium sheet. What I believe is the true 1610 collection (Berg's *P. gardnerianum*) is to be found always under number 1610 at E and K. The Kew specimen of Gardner 1610 (*P. gardnerianum*) has a label annotated in Gardner's hand with the number and the description 'A small tree, Araça de Veado of the natives, *Psidium cervorum* Gardner Mss'. Since all the 1611 (and '1610' material belonging to the same species) consists of shoots 20-30 cm long, I think it is fairly certain that there was a later mix-up of labels.

Landrum (1986) concurred with Kiaerskov in excluding *C. suffruticosa* from *Campomanesia* and fortunately lectotypified the species by the Gardner 1611 collection, although he did list Gardner 1610 as Paratype, which indicates that he probably saw only erroneous specimens of that number. I therefore propose that the paratypification of *C. suffruticosa* by the Gardner 1610 specimen be disconsidered, as it could lead to future errors.

Campomanesia suffruticosa was transferred to *Myrtus* by Niedenzu (1893) and to *Psidium* by Kiaerskov (1893), respectively as *M. bergiana* and as *P. warmingianum* (due to the exhaustion of the epithet *suffruticosa* in both *Myrtus* and *Psidium*). Niedenzu's *nomen novum* in *Myrtus* predates Kiaerskov's in *Psidium* by a few months, so the later combination *Psidium bergianum,* made by Burret (1941) based on the Niedenzu epithet, becomes the correct name for this species.

The description and illustration of *Myrtus hassleriana* agree well with the

species, although the leaves are portrayed fully grown in the illustration. Since this shrub may have sterile shoots with fully grown leaves alongside its young, fertile ones, I suspect a composition intended to convey the appearence of the leaves which, in this case, is misleading. In other details of the flower they are so similar that there is little doubt the same species is involved.

4a. *Psidium cinereum* var. *incanescens* (Mart. ex DC.) Legr., *Fl. Illustr. Catarinense* 692 (1977). Based on *Psidium incanescens.* (**Fig. 3.37**)

Syn.: *P. incanescens* Mart. ex DC., *Prodromus* 3: 234. 1828. Type. Brazil. São Paulo: 'in campis prope Taubaté' *Martius* s. n. (Holotype M n. v.).

? *P. microcarpum* Camb., *Fl. Bras. Merid.* 2: 284. 1833. Type. Brazil. Minas Gerais: 'Prope urbem S. João del Rey' *Saint Hilaire* s. n. (Holotype P? n. v.).

? *P. cuneatum* Camb., *Fl. Bras. Merid.* 2: 285. 1833. **nov. syn.** Type. Brazil. Minas Gerais: 'Prope urbem S. João del Rey. Lectum com fructibus junioribus Martio' *St. Hilaire* s. n. (Holotype P? n. v.).

P. incanescens var. *cuneatum* Berg, *Fl. Bras.* 14(1): 403. 1857. Based on *P. incanescens.* Nom. illeg. to be replaced by *P. incanescens* var. *incanescens.*

P. incanescens var. *parvifolium* Berg, *Fl. Bras.* 14(1): 403. 1857. Type. Brazil. Goiás: Chapada de Nossa Senhora d'Abadia, May 1840, *Gardner* 4163. (Holotype W n. v., Isotype K!).

? *P. incanescens* var. *rotundifolium* Berg, *Fl. Bras.* 14(1): 403, Tab. 41, Tab. 5 fig. 10 . 1857. Type. Brazil. Rio Grande do Sul: 'in campis, floret Novembri' *Sellow* s. n.; Minas Gerais: 'ad S. Rita et S. João Batista' *Pohl* 500, 'in campis ad Paracatú' *Pohl* 729 (Syntypes B - destroyed).

? *Psidium lacteum* Berg, Fl. Bras. 14(1): 403. 1857. Type. Brazil. Rio Grande do Sul: *Sellow* s. n. (Holotype B - destroyed).

Shrub or subshrub, 0.5-1.4 m, predominantly sericeous to lanate. **Hairs** yellowish when very young, soon whitish grey; young branches, undersurface of leaves, bracteoles, buds and staminal disk densely sericeous-pubescent, pubescent or lanate; inner surface of calyx lobes densely albo-sericeous, at least at tip; upper surface of leaves, petals without and fruits pubescent to glabrous; androecium and gynoecium glabrous. Older branches smooth, terete, light coloured; young branches brown, quadrangular; mature **leaves** 3-9 x 2-9.7 cm, 1-1.6 times as long as wide, obovate to almost round; apex rounded, obtuse or

abruptly-acuminate with a very small, thick, fine-tipped acumen; base acute; petiole absent to 4.5 x 1-3.5 mm. **Flowers** solitary or in a 3-flowered dichasium, axillary; peduncle 7-10 mm; bracteoles usually deciduous just before to shortly after anthesis, 3-7 x 0.75-1 mm, narrow elliptic, acute; pedicels 3.5-20 x 1-1.5 mm; mature buds 9-14 x 6-11 mm; anthesis occurring by the hypanthial cup tearing in (3-)5 lobes. Calyx lobes in young bud 5, valvate, minutely denticulate, tearing apart as the bud grows, after anthesis equal or unequal, 0.25-5 x 1-4 mm, apiculate or truncate, densely ciliate at apex; hypanthium prolonged 3.5-5 mm above stylar insertion level in bud. Petals 6-9 mm, glandular, slightly ciliate. Staminal disk 5.5-9 mm across, flat, pentagonal or circular, stamens c. 322-525 in 5-7 irregular whorls, 4.5-9 mm; anthers c. 0.5-1 mm, roundish to elliptic, with a conspicuous apical gland. Style 5.5-7 mm; ovary 2-6 mm; locules 3 or 5; ovules c. 190-296, c. 39-68 per loculus; stigma capitate. **Berry** 20-27 mm long, pear-shaped to slightly elongated, crowned by the incurved calyx lobes; seeds c. 30-35, 2.25-3 mm, irregular to reniform; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Fazenda Agua Limpa, *Alvarenga & Oliveira* 546 (IBGE). ibid., *Cesar* 701 (UB); ibid., *Cesar* 702 (E); Reserva Ecológica do IBGE, *Equipe do Jardim Botânico de Brasília* 845 (HEPH); Entre a Reserva (Ecológica do IBGE) e o DNER na BR-251, *Heringer & Paula* 17180 (UEC); Córrego Taquari, *Heringer* 3435 (IBGE); Bacia do Rio São Bartolomeu, Heringer & Filgueiras 6221 (IBGE); 500 m da margem do Lago Paranoá, *Heringer & Paula* 706 (IBGE); Vargem Bonita, *Heringer* 8749 (UB); Horto do Guará, *Heringer* 8773 (UB); C. 12 km W of Taguatinga on road to Braslândia, 1250 m, *Irwin & Souza* 10692 (UB); Brasília, 950 m, Irwin & Grear 12220 (UB); Fazenda Agua Limpa, 1100 m, *Kirkbride* 1463 (UB); Brasília, *Nascimento & Catharina* 87 (UB); Peninsula Norte, *Ratter & Bastos* 4221 (E, K); Fazenda Agua Limpa, *Ratter & Fonsêca Filho* 4331 (E, K); ibid., *Ratter & Fonsêca Filho* 4349 (E); Reserva Ecológica do IBGE, *Proença* 653 (HEPH); **Minas Gerais:** Patrocíneo, *Felfili & Nougueiras* 13 (IBGE); Paracatú, *Filgueiras* 1610 (IBGE); ibid., *Filgueiras* 1611 (IBGE); Patrocíneo, *Mendonça & Walter* 1183 (IBGE); Prope S. João del Rey, *Widgren* 529 (K, MEL); **Goiás:** Chapada de Nossa Senhora d'Abadia, *Gardner* 4163 (K); C. 12 km S of Corumbá de Goiás, 1000 m, Irwin 10855 (K); **São Paulo:** São Simão, *Leitão Filho & Martins* 13317 (UEC); Angatuba, *Ratter & Leitão Filho* 4864 (UEC); Itirapina, *Timoti* 1 (UEC); **Paraná:** Palmeira, Rio Tibagi, 780 m, *Hatschbach* 11093 (K).

Vernacular names - Araçá (Distrito Federal); Araçá-do-campo (Santa Catarina; Legrand 1977).

Distribution - *Psidium cinereum* var. *incanescens* is the common cerrado form of *P. cinereum* (see also discussion of var. *paraguariae*) and occurs throughout the southern cerrados region. *P. cinereum* var. *cinereum* probably does not occur in the core of the cerrados region, (e. g., Distrito Federal) but in Minas Gerais, São Paulo and Southern Goiás there are transitional forms which are very difficult to assign to either variety. Nevertheless, the cerrado population in general differs enough, in my opinion, to merit taxonomic status as a variety.

Discussion - *P. cuneatum* Camb. is almost certainly a synonym of this variety. In the original description, it was compared to *P. incanescens* by Cambessèdes (1833), who noted that it greatly resembled that species in the shape and indumentum of the leaves but differed in the glabrous, pear-shaped fruit. Fruits tend to lose pubescence with age and shape may vary considerably. Legrand (1977) had not seen the type of *P. cuneatum* but noted that it 'might be a future new variety of *P. cinereum* '. Although I have not seen the type of *P. cuneatum,* I have seen other material from S. João del Rey, the type locality (e. g., *Widgren* 529, the type of *P. incanescens* var. *parvifolium* Berg). This specimen agrees well with the description of Cambessèdes, and one must remember that Berg had not seen the Cambessèdes types.

P. quiquedentatum, described by Amshoff (1942) from Guyana was declared to much resemble the illustration of *P. cinereum* in *Flora Brasiliensis,* differing by the solitary flowers and the ovules in a single circle. The description fits *P. cinereum* var. *incanescens* quite well and Amshoff noted that her new species was a savanna shrub. I think it likely that this taxon may be yet another form of *P. cinereum,* perhaps equivalent *P. cinereum var. incanescens,* but it could also be a form of *P. australe* or *P. argenteum.*

4b. *Psidium cinereum* var. *paraguariae* Legr., *Fl. Illustr. Catarinense* 694. 1977. Type. Paraguay: *Rosengurtt* 5407 (Holotype MVM n. v.) (**Figs. 3.37 & 4.1 e**)

Syn.: *Psidium grandifolium* var. *intermedium* Berg, *Fl. Bras.* 14(1): 407. 1857. **nov. syn.** Type. Brazil. Rio Grande do Sul: 'in campis' *Sellow* s. n. (Holotype B - destroyed)

P. grandifolium var. *tenuinerve* Berg, *Fl. Bras.* 14(1): 407. 1857. **nov. syn.** Type. Brazil. Minas Gerais: 'Prope S. João' *Pohl* 3630 (Holotype W n. v.)

P. grandifolium var. *parvifolium* Berg, *Fl. Bras.* 14(1): 407. 1857. **nov. syn.** Type. Brazil. Minas Gerais: *Regnell* 1-129B (Holotype MEL? n. v.)

P. grandifolium Mart. ex DC., *Prodromus* 3: 234. 1828. **nov. syn.** Type. 'in Brasiliae campis ad Ypanema prov. S. Pauli' *Martius* (?) (Holotype M? n. v.)

P. grandifolium var. *genuinum* Berg, Fl. Bras. 14(1): 406. 1857. nom. illeg. to be substituted by *Psidium grandifolium* var. *grandifolium.*

P. grandifolium var. *heterophyllum* Berg, *Fl. Bras.* 14(1): 407. 1857. **nov. syn.** Type. Brazil. Minas Gerais: *Claussen* 1527 (Holotype W n. v.)

This differs from var. *incanescens* by the strikingly alate branchlets, denser indumentum and larger leaves.

Examined Material - **Brazil. Goiás:** Luziânia, 5 Ago 1979, *Heringer* 17352 (UEC); **Minas Gerais:** Campo do Meio, 15 Dez 1982, *Guimarães* 3977 (UEC); **São Paulo:** Mogi-Guaçú, 21 Oct 1977, *Leitão Filho et al.* 9131 (UEC).

Distribution - This variety has not yet been collected within the Distrito Federal but its occurrence in Luziânia, Goiás, very close to the border makes it fairly certain that it will also be found there. Probably as widely distributed as *Psidium cinereum* var. *incanescens,* it seems to be rather uncommon in the Brazilian cerrados. According to Legrand, however, it is particularly abundant in Paraguay.

Discussion - *P. grandifolium* was described based on a sterile specimen in the Martius herbarium. It is strange that Legrand did not comment on the obvious similarity between his new variety and *P. grandifolium.*

5. *Psidium firmum* Berg, *Fl. Bras.* 14(1): 390. 1857. Type. Brazil. Goiás? Bahia?: 'ad Barreiros in prov. Goyaz' *Pohl* s. n. (**Fig. 3.37 & 4.2 c**)

Shrub or subshrub, 0.5-1.3 m, glabrous. Young **leaves** appearing with the fruit; mature leaves 3-10.5 x 1.3-6.4 cm, 1.1-2.75 times as long as wide, mostly elliptic or some leaves rarely ovate or obovate; apex starting obtuse or rounded

then usually end with a short, abrupt acumen; base obtuse, rounded or subcordate; petiole 1-7 x 1.5-2.5 mm. **Flowers** axillary, solitary or in 2-6 flowered racemes; racemes apical, axillary or at basal, leafless nodes, 2-5.5 cm; peduncle stout, 0-11 mm; bracteoles deciduous between anthesis and fruit initiation or persisting in the fruit, 2-4.5 mm, linear-lanceolate; pedicels stout 4-14 x 0.75-1.5 mm; mature buds 7-13 x 6-10 mm; anthesis occurs as the 5 lobes open, sometimes with some tearing at some of the sinuses. Calyx lobes equal to subequal, 1-3.5 mm in mature bud, 2-4 after anthesis, deltoid, acute, non ciliate; hypanthium very slightly prolonged above stylar insertion. Petals 7-10 mm, ciliate. Staminal disk 5-8.5 mm across, flat, pentagonal, stamens 198-271 in 4-7 irregular whorls, 6 mm; anthers 0.75-1 mm, elliptic, with a conspicuous apical gland. Style 7-8.5 mm; ovary 3-4 mm; locules 3-5; ovules c. 152-298, 55-72 per loculus; stigma capitate. **Berry** pale green when mature, 10-27 mm long, somewhat oblate to roundish, crowned by the reflexed or somewhat flaring calyx lobes; epicarp shiny; pericarp fleshy, guava-like; placental tissue soft, whitish; seeds c. 6-44, 2-3 mm, irregular to reniform; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Fazenda Agua Limpa, 20 Sep 1979, *Cesar* 706 (E); Brasília, Eixo Rodoviário da Asa Norte , 6 Sep 1963, *Cobra & Oliveira* 148 (UB); (Reserva Ecológica do) Jardim Botânico de Brasília, 1100 m, 1 Aug 1985, *Equipe do Jardim Botânico de Brasília* 514 (IBGE); ibid., 20 Aug 1986, *Equipe do Jardim Botânico de Brasília* 708 (HEPH); ibid., 4 Oct 1986, *Equipe do Jardim Botânico de Brasília* 751 (HEPH); Rio Torto, *Glaziou* 21182 (K); RECOR, 23 Oct 1978, *Heringer & Paula* 675 (UEC); Horto do Guará, 28 Aug 1961, *Heringer* 8623 (UB); Rio São Bartolomeu, 2 Sep 1961, *Heringer* 8673 (UB); Parque do Guará, 10 Oct 1962, *Heringer* 9021 (HEPH, UB); Parque Nacional de Brasília, 18 Aug 1964, *Heringer & Belém* 9778 (UB); Rio Corumbá, 8 Sep 1964, *Heringer & Belém* 9786 (UB); Fundação Zoobotânica, 8 Sep 1964, *Heringer* 9803 (UB); Sobradinho, 10 Sep 1964, *Heringer* 9804 (UB); Chapada da Contragem, 15 Aug 1964, *Irwin & Soderstrom* 5129 (UB); Near Sobradinho, 1100 m, 27 Sep 1965, *Irwin & Souza* 8737 (UB); Between Brasília and Sobradinho, 1000 m, 13 Oct 1965, *Irwin & Souza* 9189 (UB); Região da Palma, 19 Oct 1982, Kirkbride Jr. 5032 (UB); Reserva Ecológica do IBGE, 22 Jun 1988, *Mendonça & Rocha* 1037 (IBGE); Brasília, Campus da Universidade de Brasília, 3 Aug 1981, *Nascimento & Silva* 18 (UB); (Reserva Ecológica do) Jardim Botânico de Brasília, 1050 m, 15 Oct 1986, *Proença* 608 (HEPH); ibid., *Proença* 609 (HEPH); ibid., Proença 610 (HEPH); ibid., *Proença* 611 (HEPH); Distrito Federal, (Reserva Ecológica do) Jardim

Botânico de Brasília, 1050 m, 30 Oct 1986, *Proença* 638 (HEPH); ibid., *Proença* 639 (HEPH); Parque Nacional (de Brasília), 30 Sep 1972, *Ratter & Fonsêca* 2545 (UB); Fazenda Agua Limpa, 27 Aug 1976, *Ratter & Fonsêca* 3502 (E); ibid., 1 Sep 1976, *Ratter & Fonsêca* 3521 (E); ibid., 23 Nov 1978, *Ratter & Fonsêca Filho* 4330 (E); **Minas Gerais:** Alpinópolis, 10 Sep 1983, *Carvalho et al.* 2916 (UEC); **Bahia:** Pico das Almas, *Harley* 25668 (K).

Vernacular names - Araçá, Goiabinha-rasteira (Distrito Federal).

Distribution - Confined to the core and northern part of the Cerrados region. In the Distrito Federal it grows from dense cerrado to campo limpo and also in seasonally flooded campo úmido.

Discussion - In the Distrito Federal the fruits are consumed by the local population. Cultivation on the Experimental Fruticulture Field Station of the Universidade de Brasília has proved successful.

6. ***Psidium guineense*** Sw., *Nova genera & species plantarum seu prodromus* 77. 1788. Type. San Domingo?: 'Insula principis Africes, in Domingo culta' *Swartz* s. n. (Holotypus S? n. v.) (**Fig. 3.38**)

Syn.: *Psidium polycarpon* Lamb., *Trans. Linn. Soc.* 11: 231. Tab. 17. 1813. Type. Trinidad: 'in pascuis gramineis' *Collector unknown* (Holotype BM? n. v.)

P. araca Raddi, *Mem. Mat. Fis. Soc. Ital. Sci. Modena* 18(2): 5. 1820. Type. Brazil. Rio de Janeiro: *Raddi* s. n. (Holotype possibly FI n. v.)

Campomanesia tomentosa H.B.K., *Nova genera et species plantarum* 6: 151. 1823. Type. 'Crescit com praecedente (prope Ibague Novo-Granatensium, alt. 700 hex. Floret Septembri.)' *Humboldt & Bonpland* s. n. (Holotype P? n. v.)

Psidium hians var. *cuneatum* Berg, *Fl. Bras.* 14(1):394. 1857. **nov. syn.** Type: Brazil. Minas Gerais: Sellow s. n. (Holotype B - destroyed, Isotype K!)

Psidium rubescens Berg, *Fl. Bras.* 14(1): 395. 1857. **nov. syn.**Type. Brazil. Rio Grande do Sul: Itanaré, *Sellow* s. n. (Holotype B - destroyed, Isotype K!).

P. ooideum Berg, *Fl. Bras.* 14(1): 398. 1857. **nov. syn.** Type. Brazil. São Paulo: *Sellow* 893. (Holotype B - destroyed, Isotype K!)

Psidium ooideum var. *parvifolium* Berg, *Fl. Bras.* 14(1) Supl.: 602. 1859. **nov. syn.** Type. Brazil. São Paulo: Prope Taubaté, Nov 1833, *Riedel* 1375. (Holotype

LE n. v., Isotype K!)

Psidium ooideum var. *longipedunculatum* Rusby, *Mem. Torrey Bot. Club* 3(3): 27. 1893.

P. atiraense Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier (Ser. 2)* 1: 799. 1903. Type. Paraguay: Atirós, Dec, *Hassler* 3641 (Holotype RB? n. v., Isotype K!)

P. macrophyllum Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier (Ser. 2)* 1: 797. 1903. **nov. syn.** Type. Paraguay. Cordillera: Cordillera de Altos, *Hassler* 3393. (Holotype RB? n. v., Isotype K!)

Tree, shrub or subshrub 0.7-3 m, villous to nearly glabrous. **Hairs** simple, short to long, from whitish grey to rufous; branchlets, leaves, petioles, inflorescence, buds, sepals, petals without and young fruits villous to sparsely pubescent. Mature **leaves** 3.5-9.5 x. 1.8-6.8 cm, 1-2.6 times as long as wide, obovate, elliptic or nearly round; apex usually roundish, sometimes retuse, acute or minutely acuminate, if the latter two then fine-tipped; base roundish to acute; petiole 2.5-10 x 1-2.5 mm. **Flowers** solitary, axillary or in 3-7 flowered cymes; cymes axillary or at basal, leafless nodes, 1.9-4 cm; peduncle 9-30 mm; bracteoles mostly deciduous in young bud, sometimes persisting to just after anthesis, 2-7 mm, narrowly deltoid to linear; pedicels 3-29 x 0.5-1.5 mm, the lateral pedicels in dichasia and cymes usually less than 10 mm; mature buds 8-14 x 4.5-7 mm, shaped like an 8 or the staminal globe lacrimiform and larger than the ovary; anthesis occurring by splitting and tearing of the completely or nearly closed bud into 2-5 hypanthial lobes. Hypanthial lobes unequal or if 5 subequal, 2-8 x c. 4 mm, eciliate; hypanthium prolonged above stylar insertion to the apex of the bud or nearly so. Petals white, 7-13 mm, slightly ciliate. Staminal disk 4-6 mm across, circular, stamens c. 212 in 5 irregular whorls, 7-11 mm; anthers 0.5-3 mm, oblong to linear-oblong. Style erect in bud 7-15 mm; ovary 4-6 mm; locules 3; ovules 145, 46-50 per loculus; stigma capitate. **Berry** yellowish 17-30 mm long, roundish to slightly elongated or pear-shaped, crowned by the upright or somewhat flaring hypanthial lobes; seeds c. 2-12, c. 3 mm, lenticulate or reniform; testa pale straw-coloured; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Bacia do Rio São Bartolomeu, 12 Feb 1981, *Heringer & Filgueiras* 6171 (IBGE); 1 km N of Barragem do Paranoá, 1000 m, 27 Feb 1970, *Irwin & Fonsêca* 26707 (UB); **Minas Gerais:** Pimenta, 17 Nov 1983, *Carvalho et al.* 2693 (UEC); Lavras, 9 Dec 1980, *Leitão*

Filho & Shepherd 11841 (UEC); Itutinga, 10 Dec 1980, *Leitão Filho & Shepherd* 11909 (UEC); Carrancas, 9 Dec 1983, *Leitão Filho & Semir* 15424 (UEC); 5 km de Patrocíneo na MG 230 (Patrocíneo-Ibiá), 1 Mar 1989, *Mendonça & Walter* 1250 (IBGE); ibid., *Mendonça & Walter* 1251 (IBGE); Pandeiros, 25 Oct 1972, *Ratter & Fonsêca* 2685 (E); Esmeralda, 3 Sep 1979, *Rocha* 10596 (UEC); Arco das Rivas, Sep, *Sellow* s. n. (K); Ibiá, 2 Mar 1989, *Walter & Dias* 23 (IBGE); **Goiás:** C. 15 km W of Veadeiros, 1000 m, 12 Feb 1966, *Irwin & Grear* 12667 (K); **Bahia:** *Blanchet* 3109a (F); **São Paulo:** Cajurú, 12 Oct 1985, *Bernacci* 115 (UEC); Botucatú, 23 Oct 1986, *Bicudo & Campos* 1606 (UEC); Porto Ferreira, 7 Oct 1975, *Leitão Filho & Martins* 1523 (UEC); Santo Antonio da Posse, 13 Nov 1978, *Ratter & Gouvêa* 4302 (E, K); Angatuba, 21 Nov 1983, *Ratter & Argent* 4939 (UEC); Prope Taubaté, Nov 1833, *Riedel* 1375 (K); **Mato Grosso:** C. 35 km S of Poconé on Trans-pantaneira highway, 3 Oct 1986, *Ratter & Cunha* 5239 (E); Km 8 da Estrada Vila Bela a Pontes-e-Lacerda, 5 May 1983, *Carreira & Moura* 831 (MG); **Pará:** Belém, 7 Feb 1970, *Cavalcante* 1970 (MG); Sede da Missão Tiriyó, Rio Parú de Oeste, 19 Feb 1970, *Cavalcante* 2320 (MG); ibid., *Cavalcante* 2424 (MG); Irituia, 27 Oct 1970, *Cavalcante* 2749 (MG); ibid., *Cavalcante* 2750 (MG); Icoarací, 15 Dec 1970, *Cavalcante* 2756 (MG); 17 km SE of Vigia, 50 m, 30 Mar 1980, *Davidse & Rosa* 17655 (MG); Monte Alegre, 14 Dec 1908, *Ducke* 9928 (MG); Km 12 da Estrada (de Belém ?) para São Caetano, 22 Feb 1985, *Lobato & Oliveira* 55 (MG); **Amazonas:** Manaus, 10 Oct 1955, *Chagas* s. n. (MG); ibid., 10 Nov 1955, *Coelho* 27318 (MG); Vicinity of Manaus, 20 Nov 1977, *Keel* 295 (MG); **Roraima:** SEMA Ecological Station, Ilha de Maracá, 23 Feb 1987, *Ratter & Milliken* 5837 (E); Estrada Boa Vista-Caracaraí, 15 Feb 1977, *Rosa & Cordeiro* 1490 (MG). **Paraguay. Amambay:** Caballero-cué, zwischen Rio Apa und Rio Aquidaban, *Fiebrig* 4968 (E); **Cordillera:** Cordillera de Altos, *Hassler* 3393 (K); **Missiones:** Santiago, 6 Feb 1955, *Pedersen* 3279 (E); **Province Unknown:** Atirós, Dec, *Hassler* 3641 (K); San Pedro, Lima, 6 Oct 1967, *Pedersen* 8486 (K); San Fernando, 5 Jan 1945, *Rojas* 12664 (K).

Vernacular names and uses - Araçá through most of Brazil (the usual name for species of *Psidium* except the guava), local variations being Araçá-bravo (Amazonas), Araçá-azedo (Santa Catarina; Legrand 1977) and Goiaba-da-mata (Minas Gerais). In Spanish speaking countries it is known as Arazá-guayava (Argentina, Rotman 1976), Guisaro (Costa Rica, Suarez & Esquivel 1987), Guayabillo (Argentina, Rotman 1976; Peru, McVaugh 1958), Guayaba-brava, Sacha-guayaba, Huayava [quechua] (Peru, McVaugh 1958).

Distribution - *P. guineense* is possibly the most wide-spread species of *Psidium* and grows from Mexico (Legrand 1977) to Argentina (Rotman 1976) mostly in dry forests, savannas and Amazonian campos. In the cerrados region it occurs mainly on mesotrophic cerradão. The fruits are tart and pleasant-tasting and are consumed raw or made into sweets and refreshing beverages; it is sometimes cultivated. In the Distrito Federal it is rather uncommon, probably due to the poor soils.

Discussion - The taxa placed in synonymy vary in the colour and type of indumentum, also in the leaf shape and the degree of closure of the calyx - this last character varies somewhat within the species range, from a completely closed calyx to a barely open one with a round or rather sinuous apical pore. *P. rubescens* is characterized by its long, silky, rather pale indumentum and obovate leaves which is matched by a modern collection from southern São Paulo, Ratter 4939; I dissected a bud of this latter specimen and it is typical of the species. *P. ooideum* is based upon a nearly glabrous, fruiting specimen with nearly coriaceous leaves. Landrum (1986) included *P. hians* DC. in the synonymy of *Campomanesia pubescens,* based upon a phototype. I am unable to clarify the identity of that variety, but *P. hians* var. *cuneatum* is unquestionably synonymous to *P. guineense.* It seems most extraordinary for either Berg or Landrum to have confused specimens of *C. pubescens* with *P. guineense* , so I suspect some confusion of the types. Perhaps the phototype examined by Landrum is misleading or of another specimen, or alternatively, Berg might have taken the wrong Martius specimen for the type of *P. hians.* I am inclined to believe, however, that the true affinities of this species lie with *P. guineense* rather than *C. pubescens* as the choice of epithet and original description by De Candolle ' pedunculis solitariis uni-rarissime bifloris, alabastro globoso apice hiantibus, calycis limbus cyathiformis...' would seem to indicate the first, rather than the latter, species.

7. ***Psidium longipetiolatum*** Legr., *Sellowia* 13:341. Tab. 3, Tab. 12 fig. 36. 1961. Type. Santa Catarina: Luís Alves, 350 m, 4 Nov 1954, *Reitz & Klein* 2255 (Holotype MVM n. v.) (**Fig. 3.40**)

Tree to 8 m, glabrous except for the sericeo-puberulent inner calyx lobes. Bark of the trunk very pale and smooth. Young **leaves** appearing with the flower buds; mature leaves 6-12.5 x 2.5-5 cm, 1.7-3.3 times as long as wide, obovate to oblanceolate; apex acute to acuminate, the extreme tip blunt or fine; petiole 6-15 x 0.75-2 mm. **Flowers** solitary or in axillary racemes with 4-6 flowers; bracts and bracteoles mostly deciduous in young bud, pedicels 10-18 x 1-1.25 mm; mature buds c. 9 x 5.5 mm, obovate; anthesis occurs as the 5 sepals open. Calyx lobes equal, 1-2 mm, reflexed after anthesis, becoming erect as fruit grows and finally incurved, slightly ciliate to eciliate; hypanthium slightly prolonged above stylar insertion. Petals white, 6-7 mm, roundish, ciliate. Staminal disk 4-6 mm across, circular; stamens c. 314-319, 3.5-6 mm; anthers 0.25-0.5 mm, oblong. Style 6-7.5 mm, stigma capitate; ovary c. 4 mm, locules 3-4; ovules c. 12-22, c. 2-10 per loculus. **Berry** 2-2.8 cm long, pear-shaped, when mature crowned by the incurved calyx lobes; pericarp thick, fleshy, guava-like; seeds c. 6, c. 7 mm, almost plano-convex or faceted.

Examined material - **Brazil. Distrito Federal:** Parque Nacional de Brasília, 29 Jun 1970, *Fonsêca* 1643 (UB); Parque do Guará, 19 Mar 1971, *Heringer* 11209 (HEPH); ibid., 16 Apr 1975, *Heringer* 14553 (UB, UEC); ibid., 15 Oct 1975, *Heringer* 14856 (IBGE, UEC); Reserva Ecológica do IBGE, *Silva Jr.* 54 (IBGE).

Vernacular names - Araçá-goiaba (Santa Catarina, Legrand, 1977).

Distribution - In Santa Catarina, Paraná (where it grows to 30 m tall), the Distrito Federal and probably intervening states of São Paulo and Minas Gerais, in wet forests or, in the Distrito Federal, in gallery forests. A rather uncommon species in the Distrito Federal, it has been collected only in three localities.

Discussion - It is possible that an older name will be eventually found for this species; the longest petioles overlap with the shortest in the original Santa Catarina material but the flowers are a very good match.

8. ***Psidium luridum*** (Spreng.) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 484. 1941. Based on *Myrtus lurida* . **(Fig. 3.41)**

Syn.: *Myrtus lurida* Spreng., *Systema Vegetabilium* (ed. 16) 2: 480. 1825. Type. Brazil. Uruguay: *Sellow* s. n. (Holotype B - destroyed)

M. mucronata Camb., *Florae Brasiliensis Meridionalis* 2: 294, Tab. 141. 1833. Type. Uruguay: 'In sabulosis, guabiroba incolis, lecta cum fructibus maturis Januario, florebat Decembri' *St. Hilaire* s. n. (Holotype P? n. v., Fragment MVM n. v.).

M. sellowiana Berg, *Fl. Bras.* 14(1): 413, Tab. 6 fig. 121. 1857. Type. Brazil. Minas Gerais: 'Ad Tapanhoacanga' *Sellow* s. n. (Holotype B - destroyed).

Myrtus cuspidata Berg, *Fl. Bras.* 14(1): 415, Tab. 6 fig. 124,125, Tab. 44. 1857. Type. Uruguay: 'in Montevideo' *Sellow* s. n. (Holotype B - destroyed; Fragment, MVM?).

Myrtus acutata Berg, *Fl. Bras.* 14(1): 415, Tab. 6 fig. 144. 1857. Type. Uruguay: 'in Montevideo' *Sellow* s. n. (Holotype B - destroyed).

Myrtus cuspidata var. *tetramera* Berg, Fl. Bras. 14(1): 415. 1857. Type. Uruguay: 'in Montevideo' *Sellow* s. n. (Holotype B - destroyed; Fragment MVM n. v.).

Myrtus cuspidata var. *pentamera* Berg, *Fl. Bras.* 14(1): 415. 1857. Type. Uruguay: 'in Montevideo' *Sellow* s. n. (Holotype B - destroyed; Fragment MVM n. v.).

Myrtus mucronata var. *perforata* Berg, *Fl. Bras.* 14(1): 416. 1857. Based on *Myrtus mucronata.* Nom. illeg. to be sustituted by *Myrtus mucronata* Berg var. *mucronata.*

Myrtus mucronata var. *opaca* Berg, *Fl. Bras.* 14(1): 416, Tab. 6 fig. 123. 1857. Type. Uruguay: 'in campis Montevideo, fructif. Februario, guabiroba incolis' *Sellow* s. n. (Holotype B - destroyed).

Psidium mucronatum (Camb.) Burr. non Barb. Rodr. ex Chodat & Hassler, *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 483. 1941. Illeg. later homonym.

Psidium cuspidatum (Berg) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 483. 1941. Based on *Myrtus cuspidata.*

Psidium pauciflorum (Berg) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 483. 1941. Based on *Myrtus pauciflora* .

Psidium acutatum (Berg) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 484. 1941. Based on *Myrtus acutata.*

Psidium affine Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 484. 1941. Based on *Myrtus sellowiana.*

Psidium thea Griseb., *Abh. Kön. Ges. Wiss. Gött.* 19: 287. 1874. (Holotype GOET? n. v.). Type?

Subshrub 5-30 cm, glabrous. Bark peeling on older twigs with fruit maturation. Mature **leaves** with a potent medicinal aroma, 1.4-4.8 x 0.4-2.1 cm, 1.7-3.7 times as long as wide, obovate, oblanceolate or lanceolate; apex acute or barely acuminate with a thick short acumen; base cuneate to obtuse; lower few pairs of leaves frequently much reduced; petiole 1-2.25 x 1 mm. **Flowers** solitary, apical to axillary; bracts and bracteoles mostly deciduous just before to just after anthesis, 1-3 mm; pedicels 4-17 x 0.25 mm; mature buds 4.5-6.5 x 3.5-4 mm; anthesis occurs as the 5 sepals open with some slight tearing at some of the sinuses. Calyx lobes equal, 1-2 mm, slightly ciliate to eciliate; hypanthium barely to c. 1 mm prolonged above stylar insertion. Petals 4 mm, slightly ciliate to eciliate. Staminal disk 4-5 mm across, stamens 124-154 in 3-4 irregular whorls, 3-4 mm; anthers 0.5 mm, elliptic, without a conspicuous apical gland. Style c. 5 mm; ovary 1.5-2 mm; locules 3; ovules 22-25, 5-11 per loculus; stigma subcapitate. **Berry** yellowish-pink, 12-18 mm long, roundish, crowned by the reflexed calyx lobes; epicarp dull, membranaceous; placental tissue juicy; seeds 7-14, light brown, c. 3-4 mm, elliptic; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Campus da Universidade de Brasília, 20 Nov 1968, *Belém & Barroso* 3971 (UB); Córrego Taboca, 21 Jun 1979, *Heringer & Paula* 1424 (IBGE); 500 m da margem do Lago Paranoá, 9 Nov 1978, *Heringer & Paula* 701 (IBGE); Brasília, Plano Piloto, *Heringer* 8825 (UB); Fundação Zoobotânica, 1 Feb 1962, *Heringer* 8857 (UB); Distrito Federal, Brasília, 950 m, 2 Feb 1966, *Irwin & Grear Jr.* 12210 (UB); 2 km E of Lago Paranoá, 1000 m, 26 Feb 1970, *Irwin & Fonsêca* 26671 (UB); Chapada da Contagem, 30 Nov 1981, *Kirkbride Jr.* 4577 (UB); Fazenda Agua Limpa, 11 Sep 1984, *Proença* 402 (UB); Reserva Ecológica do IBGE, 25 Nov 1986, *Proença* 660 (HEPH); **Minas Gerais:** Ituiutaba, 16 Jan 1956, *Macedo* 4175 (K).

Vernacular names - Araçá-da-pedra (Santa Catarina, Legrand 1977), Arazá, Alpa-mato, Arrayán in Argentina (Rotmann 1976).

Distribution - It grows from the Distrito Federal, which may be its northern limit, considerably south to the Province of Córdoba in Argentina. This is probably a commoner species in the Distrito Federal than the small number of collections would lead one to believe, due to undercollecting of small shrubs. It is a very common species in the campos of southern Brazil where it may form

almost pure strands on sandy, rocky, shallow ground (Legrand 1977).

Discussion - The Argentine material seems to have narrower leaves and much longer bracteoles than that from the Distrito Federal (Rotman 1976).

The fruiting plants I have seen in the field had sweet, apparently mature yellow fruit but the Heringer 701 collection describes the fruit as black; this might be a misconception, however, since Heringer was in the habit of adding details of the fruits of flowering specimens if he thought he knew the species.

The long list of synonyms is after Legrand (1977), an Urugayan specialist in Myrtaceae for 40 years. The Natural History Museum of Montevideo, where Legrand worked, houses a set of fragmentary duplicates of Uruguyan type collections, donated by Ignacius Urban at the turn of the century. Legrand (1936) actually lists the species of Myrtaceae in this collection of fragments, which include the following pertinent type collections: *Myrtus mucronata, M. cuspidata var. tetramera, M. cuspidata var. pentamera.* Other types may have been compared by Burret, a specialist in Myrtaceae at Berlin, with Uruguayan material sent by Legrand (see Legrand 1936), although Burret himself accepted all the Berg species as good (Burret 1941a)

9. ***Psidium myrsinoides*** Berg, *Fl. Bras.* 14(1): 384. 1857. Type. Brazil. Goiás: Carmo et Natividade, *Pohl* 1020 (Holotype W n. v., Isotype K!) (**Fig. 3.42**)

Syn.: *Psidium gardnerianum* Berg, *Fl. Bras.* 14(1): 389. 1857. Type. Brazil. Ceará: Serra do Araripe, Oct 1838, *Gardner* 1610 (Lectotype here designated W [specimen anotated by Berg with this name], Isolectotypes K! F!)

Tree or shrub 2-6.5 m, predominatly glabrous at maturity. **Hairs** short, light golden brown to pale rufous, the branches, petioles, margins and veins of leaves above and hypanthium sparsely pubescent when young, soon glabrescent; the pedicels, sepals within and petals without densely pubescent, the staminal disk and style with sparse hairs at extreme base; mature vegetative parts and fruit glabrous. Bark of the trunk and older branches splitting in a brick-like pattern and detaching in thick, transversal rings, smooth and pale underneath. Branchlets terete, slightly flattened near the nodes. Young **leaves** appearing with the flower buds. Mature leaves 2.6-10.2 x 1-4.8 cm, 1.6-3.4 times as long as wide,

elliptic-lanceolate or barely oblanceolate; apex rounded, obtuse or barely acuminate, the acumen thick, short, round-tipped; base usually obtuse or barely acute, sometimes abruptly rounded or subcordate; petiole 0.25-4 x 0.5-2 mm. **Flowers** axillary, solitary, in 2-10 flowered precocious racemes or in axillary 3-flowered dichasia; racemes axillary or lateral at leafless nodes; peduncle 1.5-3 cm; bracts deltoid or subfoliaceous; bracteoles mostly deciduous in young bud, 2-3 mm, linear, ciliate; pedicels 3-21 x 0.25-1 mm; mature buds 6-10 x 3.5-7 mm, pear-shaped to almost clavate; anthesis occurs as the 5 lobes open and tear the hypanthial cup at the sinuses. Calyx lobes equal, 0.25-1 in bud, sinuous, 1-2.75 x 2-3 mm after anthesis, sometimes splitting transversally along staminal disk, rounded or obtuse; hypanthium prolonged 1-3 mm above stylar insertion level. Petals 3.5-7 mm, round to elliptic, densely ciliate to ciliate. Staminal disk 3.25-6 mm across, flat, pentagonal or almost circular, stamens c. 163-196 in 4 irregular whorls, 3.5-8.5 mm; anthers 0.25-0.75 mm, roundish to elliptic, the apical gland inconspicouous, with scattered dorsal glands. Style 5-10 mm, incurved in bud; ovary 2.5-4 mm; locules 3-4; ovules c. 105-146, c. 25-41 per loculus; stigma capitate. **Berry** 1.5-3 cm long, substipitate when young but soon roundish, crowned by the upright or slightly diverging calyx lobes; seeds light-brown, c. 13, 2-4 mm, lenticulate, reniform or irregularly faceted; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Setor de Indústrias, 12 Nov 1971, *Ferreira* 1270 (HEPH); Chapada da Contagem, 1000 m, 27 Oct 1965, *Irwin & Souza* 9581 (UB); Immediately E of Lago Paranoá, 975 m, 12 Dec 1965, *Irwin & Souza* 11237 (UB); Barragem do Lago Paranoá, 1000 m, 27 Feb 1970, *Irwin & Fonseca* 26705 (UB); Fazenda Agua Limpa, 1100 m, 3 Oct 1980, *Kirkbride* 1391 (UB); ibid., 18 Feb 1981, *Kirkbride* 1470 (UB); ibid., 18 Feb 1981, *Kirkbride* 1478 (UB); Reserva Biológica das Aguas Emendadas, 1000 m, 8 Oct 1982, *Maury* 244 (HEPH, UEC); Reserva Ecológica do IBGE, 25 Nov 1986, *Proença* 659A (HEPH); ibid.,, *Proença* 659B (HEPH); ibid., *Proença* 659C (HEPH); Reserva Biológica das Aguas Emendadas, 6 Feb 1988, *Proença* s. n. (HEPH); (Reserva Ecológica do) Jardim Botânico de Brasília, 22 Feb 1989, *Proença* s. n. (HEPH); FERCAL, 8 Jan 1987, *Ramos & Proença* 810 (HEPH); Fazenda Agua Limpa, 26 Oct 1976, *Ratter & Fonsêca* 3839 (E); Planaltina, Centro de Pesquisa Agropecuária dos Cerrados, 27 Nov 1978, *Ratter & Fonsêca Filho* 4339 (E, K); Planaltina, Centro de Pesquisa Agropecuária dos Cerrados, 27 Nov 1978, *Ratter & Fonsêca Filho* 4341 (E, K); **Minas Gerais:** Reserva do Grande Sertão Veredas, 5 Nov 1990, *Ratter & Silva* 6357 (IBGE); **Goiás:** Formosa, 20 Oct 1965, *Duarte* 9392 (K); ibid., 26 Oct 1964,

Heringer 9924 (K); ibid., 900 m, 11 Oct 1965, *Irwin & Souza* 9132 (UB); *Pohl* 1019 (K); Carmo et Natividade, *Pohl* 1020 (K); Near Corumbá de Goiás, 16 Oct 1980, *Ratter & Rocha* 4541 (E, K, UEC); **Piauí:** Oeiras, 400 m, Nov 1986, *Castro* s. n. (UEC); **Ceará:** Serra do Araripe, Oct 1838, *Gardner* 1610 (F, K); .

Vernacular names - Goiabinha (Goiás), Araçá-de-viado (Ceará).

Distribution - This is a species of the core and northern cerrados region, occurring from Goiás to the Chapada do Araripe in Ceará. It has vegetative reproduction by sucker roots and can form dense populations as one of the few trees in certain kinds of open, grassy cerrado, alongside several species of *Vochysia* (Ratter collection no. 4541; personal observation) such as *V. elliptica* and *V. thyrsoidea.* This is a strong indication that it is very tolerant of high levels of aluminium in the soil, as the latter species are obligate accumulators. It also occurs sporadically in ordinary cerrado.

Discussion - *Psidium myrsinoides* Berg and *P. gardnerianum* Berg, both published in *Flora Brasiliensis,* have equal priority as names for these species. *P. myrsinoides* is preferable as the name because it is uncomplicated, whilst *Psidium gardnerianum* was based on a collection whose number was eroneously used for another (I am hereby proposing that *Psidium gardnerianum* be lectotypified exclusively by the Gardner 1610 specimen annotated with that name by Berg which is presumably to be found at W; see discussion of *P. bergianum*), and is also an earlier homonym for *P. gardnerianum* Kiaersk. Although neither of these problems would be enough to invalidate the name if it were the only one available, when there is a choice involved it makes the selection of *P. myrsinoides* preferable.

Berg compared *P. myrsinoides* to *P. myrsinites* DC., whose type I have not been able to examine - if the two species should prove to be the same, the older de Candolle epithet will have priority.

10. ***Psidium pohlianum*** Berg, *Fl. Bras.* 14(1): 390, Tab. 6 fig. 119. 1857. Type. Brazil. Goiás: *Sellow* s. n. (Holotype B - destroyed, Isotype K!) (**Fig. 3.43**)

Syn.: *Myrtus rigida* Berg, *Fl. Bras.* 14(1):417.1857. **nov. syn.** Type. Brazil. São

Paulo: 'in campis ad Paranapitanga distr. Itapeva' *Sellow* s. n. (Holotype B - destroyed, Isotype K!)

M. blanchetiana Berg, *Fl. Bras.* 14(1): 418. 1857. **nov. syn.** Type. Brazil. Bahia: Serra da Jacobina, *Blanchet* 3310. (Holotype B - destroyed, W, Isotype F!)

Psidium deltosepalum Barb. Rodr. ex Chodat & Hassler, *Bull. Herb. Boissier (Ser 2)* 1:799. 1903. **nov. syn.** Type. Paraguay. Caaguazú: 'In regione fluminis Capibary iter ad Herbales montium Sierra de Maracayú' *Hassler* 4400 (Holotype RB? n. v., Isotype, K!)

Psidium blanchetianum (Berg) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 483. 1941a. Based on *Myrtus blanchetiana.*

Psidium rigidum (Berg) Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 484. 1941a. Based on *Myrtus rigida.*

Tree, shrub or subshrub 0.2-1.7 m, glabrous. Mature **leaves** subsessile, 1.5-9.6 x 1-4 cm, 1.5-2.6 times as long as wide, elliptic or obovate; apex round, rarely retuse or abruptly acuminate with a short thick acumen; base usually acute or obtuse, some leaves abruptly subcordate at extreme base; petiole barely present to 2.25 x 1-2 mm. **Flowers** solitary, axillary; bracts sometimes subfoliaceous; bracteoles usually deciduous between anthesis and young fruit stage, 2-6 mm, linear to lanceolate; pedicels 4-20 x 0.5-1 mm; mature buds 5-8 x 4.5-5.75 mm; anthesis occurs as the 5 lobes open, sometimes with slight tearing at some of the sinuses. Calyx lobes equal to subequal, 1.5-4 mm, deltoid, acute, non ciliate; hypanthium very slightly prolonged above stylar insertion. Petals 6 mm, non ciliate. Staminal disk 4.5-6 mm across, flat, pentagonal, stamens 173-190 in 4-6 irregular whorls, 2-5 mm; anthers 0.5 mm, elliptic, the apical gland obscure. Style 5-10.5 mm; ovary 2.5 mm; stigma capitate; locules 3; ovules c. 24-39, c. 8-13 per loculus. **Berry** bright yellow, 16-25 mm long, roundish, crowned by the stiff, upright calyx lobes, these loosing sharp tip with maturity; epicarp dull, coriaceous; placental tissue fleshy; seeds c. 6-8, c. 6-7 mm, irregular to lenticulate; testa yellowishe cream; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Fazenda Agua Limpa, 11 Sep 1979, *Cesar* 696 (E); Península Norte, 20 Oct 1982, *Heringer* 18602 (IBGE); 10 km E of Planaltina, 1150 m, 10 Oct 1965, *Irwin & Souza* 9107 (UB); Lago Paranoá próximo à confluencia do Córrego Bananal, 20 Mar 1982, *Mendonça & Pereira* 164 (IBGE); Reserva Ecológica do IBGE, 25 Nov 1986, *Proença* 661

(HEPH); Reserva Biológica de Aguas Emendadas, 1100 m, 6 Feb 1989, *Proença* 701 (HEPH); **Minas Gerais:** Arco das Rivas, Sep, *Sellow* s. n. (K); **São Paulo:** 'in campis ad Paranapitanga distr. Itapeva' *Sellow* s. n. (K); Mogi-mirim, 12 Mar 1980, *Leitão Filho & Rodrigues* 11174 (UEC); Angatuba, 13 Nov 1983, *Ratter & Argent* 4854 (UEC); **Mato Grosso do Sul:** Cuiabá, 165 m, 5 Nov 1977, *Macedo & Duarte* 961 (UEC); **Bahia:** Serra da Jacobina, *Blanchet* 3310 (F); Pico das Almas, *Harley* 15596 (K); **Paraguay. Caaguazú:** 'In regione fluminis Capibary iter ad Herbales montium Sierra de Maracayú' *Hassler* 4400 (K).

Distribution - A widely distributed cerrados region taxon, this species grows from Caaguazú in Northern Paraguay to Bahia.

Discussion - The three epithets published in the *Flora Brasiliensis* have equal priority, however only one, based upon a fruiting specimen, was in *Psidium.* The other two were put by in *Myrtus* by Berg due to the open buds with almost free calyx lobes. I am grateful to Eimear Nic Lughadha of the Royal Botanic Garden at Kew for recognizing the synonymy of *Myrtus rigida* and for a special loan of the Harley no. 15596 collection being studied by her at the time.

11. ***Psidium pubifolium*** Burr., *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 484. 1941. Based on *Myrtus ovalis.* **(Fig. 3.44)**

Syn.: *Myrtus ovalis* Berg, *Fl. Bras.* 14(1): 418. 1857. Type. Uruguay: 'Montevideo' *Sellow* s. n. (Holotype B - destroyed)

? *Myrtus formosus* Barb. Rodr., *Myrtacées du Paraguay* 17, Tab. 21. 1903. Type. Paraguay: 'Sierra de Maracayu, in campo Ipê hú, in alto planitie et decliviis' *Hassler* 5079 (Holotype RB? n. v.).

? *Psidium formosum* (Berg) Burret, *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 485. 1941. Type. Based on *Myrtus formosus.*

Subshrub 0.4 m. Hairs simple, whitish-cream, very pale yellow or yellow-grey, short to medium-long; young vegetative parts, peduncles, pedicels and sepals without densely pubescent; ovary velutinous; sepals within albo-velutinous; mature leaves retaining sparse pubescence; petals puberulous without; petals within, androecium and gynoecium glabrous. Mature **leaves** 3.4-6.5 x. 1.7-3.4 cm, 1.4-2.4 times as long as wide, elliptic to obovate; apex

rounded and frequently mucronate or apiculate; base obtuse or barely acute; petiole 2-3 x 1.25-1.75 mm. **Flowers** solitary or in 3-flowered dichasia, axillary or at basal, leafless nodes; peduncle c. 18 mm; bracteoles probably deciduous just before to just after anthesis, 2.5-4 mm; pedicels 6.5-23 x 0.75-1 mm; mature buds c. 6.5 x 6 mm; anthesis occurs as the 5 sepals open. calyx lobes c. 1 x 2-3 mm, rounded or obtuse, densely ciliate; hypanthium prolonged c. 1 mm above stylar insertion. Petals 6.5-10 mm, slightly ciliate. Staminal disk 6 mm across, flat, pentagonal; stamens c. 166, in c. 4 irregular whorls; anthers 0.25-0.75 mm, elliptic, the apical gland inconspicuous. Style 6.5-10.5 mm; ovary 2.5-3 mm; locules 3; ovules c. 74, c. 23-26 per loculus. **Fruit** not seen.

Examined material - **Brazil. Distrito Federal:** Reserva Ecológica do IBGE, 22 Jan 1987, *Silva & Vianna* 329 (IBGE); **Bahia:** Pico das Almas, DATE? *Harley* 26608 (K).

Vernacular names - Arazá (Argentina, Rotman, 1976), Araçá, Araçazeiro, Araçá- do-Campo (Santa Catarina, Legrand 1977).

Distribution - From northern Uruguay and Argentina, Paraguay, and Brazil up to the Pico das Almas in Bahia. Legrand believed that this species ranged no further north than Santa Catarina. This does not seem to be the case, as the species also occurs quite far north in the more open, grassy kinds of cerrado.

Discussion - *Psidium pubifolium* is based on a Sellow collection from Uruguay The only Distrito Federal collection of this species differs from the descriptions (Berg 1857, Legrand 1977, Rotman 1976) by its shorter bracteoles, more rounded calyx lobes and occasional 3-flowered dichasia. The leaves and 3-flowered dichasia are matched by the Harley no. 26608 collection from Pico das Almas, Bahia, which has typically acute calyx lobes, so perhaps this character varies locally.

This species is very close to *P. bergianum* and in both species flowering seems to be triggered by burning. In *P. pubifolium,* however, the bracteoles are only as long as the ovary and the calyx lobes are shorter and rounder. I have not examined the type of *M. formosus* Barb. Rodr. but the illustration and description are quite detailed and are a very good match for the species.

12a. *Psidium rufum* var. *widgrenianum* (Berg) C. Proença, **nov. stat.** Based on *Psidium widgrenianum.* **(Fig. 3.45)**

Syn.: *P. widgrenianum* Berg, *Fl. Bras.* 14(1): 392. 1857. Type. Brazil. Minas Gerais: *Widgren* 534 (Holotype MEL? n. v.)

Psidium macrospermum Berg, *Fl. Bras.* 14(1): 392. 1857. Type. Brazil. Minas Gerais: 'Ad S. (João del?) Rey' *Sellow* 12 (Holotype B - destroyed, Isotype K!)

Tree or large shrub 3.5-6 m, most parts densely pubescent when young; hairs medium long, rufous to golden brown; young branches, leaves, petioles, pedicels, buds, petals without, style and fruit pubescent; mature leaves nearly glabrous on the upper surface, some hairs persisting on the principal veins of the undersurface; petals within and androecium glabrous. Older branches terete, bark persistent or peeling in thin, elongated flakes. Mature **leaves** 2.6-12 x 1.4-5.3 cm, 1.6-3.5 times as long as wide, obovate or oblanceolate; apex with a short almost pointed or blunt acumen, rarely obtuse or rounded; base cuneate to acute, decurrent on petiole; petiole 2.5-14 x 1-1.5 mm. **Flowers** solitary or in a 2-4 flowered precocious raceme; raceme axillary or at basal, leafless nodes; bracts and bracteoles mostly deciduous in young bud, 4-4.5 mm, linear to lanceolate; pedicels 4.5-18 x 0.5-2 mm; mature buds 7-9 x 6-8 mm; anthesis occurs asthe 5 lobes open and tear the hypanthial cup. Calyx lobes equal, 1-1.5 in bud to 3 x 3-6 mm after anthesis, widely deltoid or almost rounded, obtuse, densely ciliate; hypanthium prolonged c. 1 mm above stylar insertion level. Petals 6 mm, almost eglandular, ciliate. Staminal disk 7-9 mm across, flat or outcurved, pentagonal to almost round; stamens c. 230-236 in 5 irregular whorls, 6 mm; anthers 0.5-1 mm, roundish to elliptic. Style slightly curved in bud, 7 mm; ovary 2-3 mm; locules 3; ovules c. 28, c. 7-9 per loculus; stigma subcapitate. **Berry** 13-28 mm long, roundish to pear shaped, crowned by upright, outcurved or at maturity slightly incurved calyx lobes; seeds c. 2-3, 6-8 mm, faintly angular to almost round; testa very pale brown; embryo pimentoide.

Examined material - **Brazil. Distrito Federal:** Bacia do Rio São Bartolomeu, *Heringer & Filgueiras* 2960 (IBGE); ibid., *Heringer & Filgueiras* 4872 (IBGE); Reserva Biológica das Águas Emendadas, *Proença* 395 (HEPH); Reserva Ecológica do IBGE, *Proença* 670 (HEPH); Taguatinga Norte, Silva 336 (IBGE); **Minas Gerais:** Uberlândia, Fazenda do Glória, *Araújo* 66 (Uberlândia); Diamantina, 1270 m, *Mexia* 5714 (K); Caldas?, *Regnell* 3-585 (K); Arco das

Rivas, *Sellow* s. n. (K); **São Paulo:** Santa Rita do Passa Quatro, 700 m, *Castro* 19729 (UEC); Angatuba, *Ratter & Leitão* Filho 4872 (UEC); **Rio de Janeiro:** Environs de Rio de Janeiro, *Glaziou* 13446 (K); Environs de Rio de Janeiro, Nova Friburgo, Suspiro, *Glaziou* 14845 (K).

Examined material of *Psidium rufum* var. *rufum* DC. - **Brazil. Minas Gerais:** *Martius* s. n. (Holotype B - destroyed, Isotype M!); *Martius* 779 (K); *Sellow* 355 (K); 'Prope Penha et Sabará' *Riedel* 572 (K).

Vernacular names - Araçá (Minas Gerais).

Distribution - The species has a limited distribution in Rio de Janeiro, Minas Gerais and the Distrito Federal (probably Goiás also). In the latter locality it grows exclusively in the denser cerradões or gallery forests.

Discussion - In my opinion this taxon merits only varietal recognition under *Psidium rufum,* which has a denser indumentum, bullate leaves when mature and rather larger buds. I have seen the type of *P. rufum* and other specimens cited by Berg (1857, 1859) as such but not the type of *P. widgrenianum* itself. The description, however, indicate that the type of the latter species has rather small, coriaceous leaves, with secondary veins only impressed such as I have observed in other material from the type locality or thereabouts (Regnell 3-583 from Caldas, and Mexia 5714 from Diamantina). Indeed, this seems to be the comonest form of *Psidium rufum.* I have examined the type of *P. macrospermum* and it is undoubtedly a synonym of var. *widgrenianum,* the nearly glabrous leaves being characteristic of fruiting material.

Plants from the Distrito Federal have rather large leaves like var. *rufum* but resemble *Psidium rufum* var. *widgrenianum* in petiole length, shape and texture of leaves, size of buds and type of indumentum.

13. *Psidium sartorianum* (Berg) Nied., *Nat. Pflanzenfam.* 3(7): 69. 1893. Based on *Mitranthes sartorianum.* **(Fig. 3.46)**

? *Calyptranthes eugenioides* Camb., *Florae Brasiliensis Meridionalis* 2: 370, Tab. 155. 1833. Type. Brazil. Minas Gerais: 'Prope Bom Jardim in parte deserta occidentalique provinciae quam vocat Sertão. Florebat Septembri' *Saint Hilaire* s. n. (Holotype P? n. v.).

Mitranthes sartorianum Berg, *Linnaea* 27: 248. 1856. Type. Mexico: Mirador, *Sartorius* s. n. (Holotype B - destroyed).

Calycorectes protractus Griseb., *Catalogus plantarum cubensis:* 284. 1866. TYPE? (Holotypus GOET? n. v.)

Calyptropsidium sartorianum (Berg) Krug & Urban, *Bot. Jahrb.* 19: 581. 1894.

Calyptranthes tonduzii Donn. Smith, *Bot. Gaz.* 23: 245. 1897.

Mitropsidium sartorianum (Berg) Burret, *Notizbl. Bot. Gard. Berlin-Dahlem* 15: 487. 1941.

? *Mitranthes eugenioides* (Camb.) Berg, *Fl. Bras.* 14(1):355. 1857. Based on *Calyptranthes eugenioides.*

? *M. eugenioides* var. *oblongifolia* Berg, *Fl. Bras.* 14(1):355. 1857. Based on *Calyptranthes eugenioides.* Nom. illeg. to be substituted by *Mitranthes eugenioides* var. *eugenioides.*

Psidium solisii Standl., *Field. Mus. Publ. Bot.* 23: 133. 1944. TYPE?

Tree to 20 m, appearing glabrous. Hairs minute, wiry; twigs, petioles, pedicels, midvein and basal part of the leaf upper surface puberulous. Trunk to 60 cm of circumference, the bark pale grey, smooth. Young branches terete. Mature **leaves** 1.7-4.8 x 0.7-1.9 cm, 1.9-3.5 times as long as wide, lanceolate or oblanceolate, apex acute or slightly acuminate, blunt or rounded at tip, base cuneate or atenuate; petiole 1-2.5 x 0.75 mm. **Flowers** solitary or in 3-flowered dichasia, in the axiles of young, tender leaves; peduncle 7-18 cm, pedicels 0.75-7 x 0.5 mm; mature buds 6 x 3-3.5 mm; anthesis occurring either through a pendulous calyptra or by tearing of the completely closed bud into 2-5 lobes. Hypanthial lobes, if present, irregular; hypanthium not prolonged above stylar insertion level. Staminal disk 4.5-5.5 mm across; ovary 2.5-3 mm, locules 3. **Berry** pale yellow-green, 10-12 mm long, roundish or slightly oblate, crowned by the staminal disk remnant which is split in several places, the calyx lobes or calyptra abscissed; pericarp thin; seeds 3-5, dull straw-colour to pale brown, 6-6.5 mm, irregularly angular.

Examined material - **Brazil. Distrito Federal:** Horto do Guará, 19 Aug 1961, *Heringer* 8594 (NY n. v., xerox of specimen examined); **Minas Gerais:** Uberlândia, Fazenda do Panga, 16 Sep 1989, *Araújo* 92 (Uberlândia); **Goiás:** 15 km ao S. de Flores de Goiás, 12 May 1990, *Silva* 36.125.90 (IBGE).

Distribution - This species is well known form Mexico and Central America

(Amshoff 1958). It also occurs in mesotrophic forests in Goiás and Minas Gerais and has been collected, albeit only once, in the Distrito Federal.

Discussion - As I have not examined flowering material, the description lacks certain details. Readers are referred to Amshoff (1958) for a more complete description likely to apply to Distrito Federal material.I am indebted to Dr. Leslie Landrum for sending me a xerox of the Heringer collection from the Distrito Federal and identifying the species.

The description and illustration of *Calyptranthes eugenioides* Camb., based on a St. Hilaire collection from Minas Gerais, fit in very well with this species (sensu McVaugh, 1963). In the St. Hilaire specimen the calyx, although opening by a calyptra, has a pore with 5 minute teeth at the apex and the petals are somewhat pubescent, but I believe they are conspecific. The Cambessèdes (1833) epithet is the oldest for this species but, fortunately for taxonomic stability, the new combination *Psidium eugenioides* which priority would require is inadmissable due to the existence of *Psidium eugenioides,* published by Cambessèdes himself for another species [*P. eugenioides* Camb. = *Campomanesia eugenioides* (Camb.) Legr.].

Berg transferred *Calyptranthes eugenioides* to *Mitranthes* and described a new variety, *M. eugenioides* var. *ovata.* I have seen the type of this variety, a Salzmann collection from Bahia, and it does not belong to *Psidium sartorianum:* it is in fact conspecific to recently described *Campomanesia espiritosantensis* Landrum (1987), of which I have seen a paratype. Burret (1941a) who had access to all the Berg types in Berlin, also realized that *C. eugenioides* var. *ovata* belonged to a different species and excluded it from *Calyptranthes eugenioides* (*Mitropsidium eugenioides* to him), furthermore synonymizing it to another Berg name, *Mitranthes gardneriana* (which Burret called *Mitropsidium gardnerianum*) also from Bahia. Thus *gardneriana* may be the oldest epithet for *Campomanesia espiritosantensis* ; it cannot be applied, however, as the epithet *gardneriana* is exhausted in *Campomanesia.*

It is very rare that different species, let alone different genera, be considered varieties of the same species by such a taxonomic splitter as Berg. In this case, however, we must remember that Berg had not seen the Cambessèdes types and the description of var. *ovata* would seem to indicate that he did not dissect the ovary, which is 6-8 locular in *C. espiritosantensis* and 3-locular in *P. sartorianum.* Indeed, Landrum himself in the description of *C. espiritosantensis* states that '... C. *espiritosantensis* might be confused with

some species of *Psidium* with closed calyces, e. g. *P. sartorianum...*'

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